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WRITTEN FOR
INDUSTRIAL EXECUTIVES
AND
MECHANICAL ENGINEERS

DEVOTED TO
LABOR-SAVING MACHINERY
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LABOR MAINTENANCE

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For Victory Through Industry

The Country's Call is:—Serve Together, and for Your Country's Sake, Produce! Produce!!

By Hon. William C. Redfield

Secretary of the Department of Commerce, U. S. A.

This opening article is filled with truths. With keen insight and wise counsel the author tells American industrial executives that in our strife for victory industry must conquer her domestic foes—the separation of science from industry, industrial wastage, lack of industrial and commercial education, ignorance of manufacturing costs; employers must accept the high privilege of leadership and see to it that labor's burdens are less rather than more; all must coöperate, for this is the need of the hour.

Hon. William C. Redfield *has been Secretary of Commerce in President Wilson's Cabinet since March 4, 1913. His qualifications for this important post of leadership include thirty years of manufacturing and commercial experience in the positions of director, treasurer, vice-president and president of several industrial firms. He has always been active in public affairs and was a member of the Sixty-second Congress for the Fifth District of New York. He is the author of numerous papers on economics and industrial topics, and (1912) of a well received book "The New Industrial Day."*

As an American manufacturer looks back to the days before the war he sees that the old past is dead. Between him and it is a great gulf fixed. About him he sees industry as a whole in rapid transition from an economic organism made for peace into a great war machine. There is novel talk of "non-essential industries," meaning industries not necessary for war purposes. Many a factory, whose owners never meant it to be part of the war power, is making munitions. In a new and most impressive manner the resources of the land, human, financial, industrial, agricultural, mineral, are being assembled for war. As he looks forward there is little that is clear, but he knows that his foreign competitors plan to re-enter the field with a fixed purpose to regain the places therein from which, by causes incident to war, America has for the present at least displaced them.

What have we to learn from the past? How shall we deal with the present? How be sure of the future?

INDUSTRIAL WASTERS OF THE WORLD

Of the past it would not be too much to say that we were so wasteful that we might almost take the familiar initials I. W. W. and adopt them ourselves as meaning the Industrial Wasters of the World. Examples of costly wastes abounded throughout the land for lack of thought or for lack of care. It is very well to say that the natural effect of competition is to make men study their own business and run it efficiently. The record shows the reverse is often true.

The Department of Agriculture will say that we waste 65 per cent. of a tree in turning it into lumber, and make a further waste of several times ten million dollars yearly in drying the lumber when made. Vast amounts of scrap wood available for making pulp or alcohol or other valuable products are burned or allowed to rot. Even in these recent days of fuel shortage old railway ties are burned as waste, not as fuel. Whoever is in close touch with the wonderful work of the Bureau of Standards, or the Forest Products Laboratory, knows how lamentable the industrial wastes are and how indifferent or ignorant most of us are about them. We like to be lavish. Almost we would prefer to hand over a roll than to save a few cents. This wastefulness is one of our great industrial weaknesses. We cannot compete and we ought not to expect to compete with nations like France or Germany so long as we are wasteful and they are thrifty.

We Must Apply Science in Industry

We have usually ignored science in industry and at times speak of a "practical" man as preferable to a scientific one. Science in America has much to tell industry, but has rarely had full chance to tell it. Industries indeed exist in which science and research are used to the full, and the habit spreads. Still, one manufacturer for lack of chemical science wasted 80 per cent. of the raw material he bought. Another threw away valuable scrap material because he did not know the simple process requisite to extract paraffin wax from paraffin paper scrap. A third loses scrap products to the value of thousands per annum because science has not told him a simple way of utilizing them.

The beehive coke oven has been an example both of industrial waste and the absence of science. It ought almost to be a social reproach for men to use anything so hopelessly wasteful. Germany has created her whole dyestuff industry, and a large part of her explosive industry, out of products that we have thrown away. We harness Niagara, but let the heat from old type coke ovens, that would continuously produce over half a million horse power, disappear in the atmosphere while valuable by-products run neglected to waste. The voice of science would tell men to use sawdust and slabs for making grain alcohol and other products, but in our heedlessness we usually burn them.

Waste in our industries is almost beyond belief. Looking back at what has been done in the saving of by-products (though it is relatively little of what is possible) we need not be surprised at the statement that we are as a whole possibly wasting as much as our total wage cost in industry. Much of the wood wasted in making lumber is suitable for making pulp from which in turn paper, pulleys, rugs, furniture, and other things could be made. To an old whaler it might seem absurd to tell him of great wastes in the business he knows so well, yet within recent months whale meat, hitherto unused, had become an established article of food in the best hotels in several large cities, and about four tons of this meat of good quality are taken from each whale. The demand for it is greater than the present supply. The intestines of the whale formerly thrown away are found to make good leather of which about 300 square feet are taken from each whale. The fur seal was for years taken for his fur with the incidental use of part of the meat as food. Most of the carcasses were thrown away. Within a few months it has been found possible to use all the carcass of the fur seal, the blubber for oil, the meat for food, the bones for fertilizer, and other parts of the animal for various useful purposes. In years past millions of seals and thousands of whales have been taken and the products now saved were then lost.

It is, of course, true that had our own wastes been fully realized more would have been done to save them, but this is only a confession that in large part we went along by rule of thumb, without accurate knowledge of what we were doing.

We Must Know Our Manufacturing Costs

Some months ago the Department of Commerce had occasion to examine into an industry. In it were three large concerns, each employing many men, some of them many hundreds of men. One concern had not taken an inventory up to 1912 for 25 years. Another had a good cost accounting system for actual labor and material but took no account of such "overhead" matters as depreciation, taxes, wear and tear and interest. A third kept its books by single entry bookkeeping. Some years ago I said to my employer "Mr. So-and-so, you sell that machine for $8,000, do you not?" He said, "Yes." I replied, "I find it costs you $9,000 to build." He said, "Young man, you are very arrogant. You have been her six months and I have been here thirty years. Don't you suppose I know my own business better than you do?" I was earning my living as his accountant and did not then venture to tell him that he ought to have known his own business but was in fact in dark ignorance of much about it.

The Chairman of the Federal Trade Commission, himself a manufacturer, said to the Ohio Bankers' Association in September, 1916:

> The unfortunate fact is that a large proportion of the business men of the country do not know their costs accurately. Most of the big companies have good cost systems, but thousands of the smaller concerns have neither adequate nor accurate cost accounting.
>
> *Only ten per cent of our manufacturers and merchants know the actual cost to manufacture and sell their products;* 40 per cent estimate what their costs are, and 50 per cent have no method, but price their goods arbitrarily. Most of the manufacturers and merchants who do not know what their goods cost are basing their selling price on what their competitors sell for, and with only this knowledge for a basis they are frequently cutting prices and demoralizing the industry in which they are engaged.

We Must Train Our Children in Industry

While Germany has trained her children in the principles and practice of industry, so that her factories have had trained forces led by trained men, we have been content till to-day to talk about industrial education rather than to act upon it, and what we know about employment as a scientific act, involving study of human capabilities and the fitting of the man to the place, leaves volumes to be desired.

It need hardly be said that these warnings do not apply everywhere alike, and that there are many fine examples in our industries of due care to all of them. They account possibly for some successes that are perhaps attributed to less creditable causes; but the very fact that these fine factories are exceptional proves the rule to be otherwise. At their best American manufacturers are the ablest manufacturers in the world. At their average I wish the same could be said. Yet, as an old church service used to say, "Friends, we are pursuaded better things of you, and things which accompany salvation."

We Must Conquer Four Domestic Foes

Four domestic enemies of American industry exist. Perhaps I may say they are the four greatest enemies of our commerce. They are foes of our own household; commercial sins which we ourselves must cast out. These four foes are:

Separation of science from our industry.

Industrial wastage.

Lack of industrial and commercial education.

Ignorance of costs.

Here are four handicaps indeed, foemen worthy of our steel. Our commercial future will depend in largest part on how we deal with them. We do not lack examples elsewhere of these sins and of their results or of what happens when there sins are cast out. Germany had thorough industrial and commercial education and applied science to her industries; she took a great place in the world largely because of this. She linked science to trade, diminished wastes and prospered thereby. No manufacturers know better what goods cost to make than the men in whose hands industry is but the servant of science. We must not be above learning from the experience of our enemies. In time we shall meet them again in more peaceful contests. If we are then unprepared we shall not get, shall not deserve, a place in the industrial sun.

WE MUST HEED THE WARNING OF INDUSTRIAL DANGER

These are serious words. Were I asked the message which at the end of thirty years connection with industry and after five years as the head of the Department of Commerce, I would leave as a warning against industrial danger, as a sign-post for the future commercial path, it would be this:

Educate young people for the work of the world.
Make industry the servant of science.
Know costs and the causes of costs.
Hunt for wastes and stop them.

When we come again into competition with Great Britain and Germany after the war they will certainly know what they are doing, and unless we change many of our business habits we may not. The prospect is an unpleasant one unless we adapt ourselves to new conditions. As surely as time passes, if there are more scientific brains in your shop than in mine, you will win out and ought to do so. As surely as can be, if Germany puts more science into her business than we do she will beat us out, and we shall take second place, and ought to do so. The problem of "after the war" is whether American business men have vision to see far, to think in the large, and have the courage and clearness of mind to be their own severest critics. Some talk of tariffs, others of labor. These may be important incidents. The essential fact, however, is that we ourselves, are to be tested. As Caesar said:

The fault, dear Brutus, is not in our stars
But in ourselves if we be underlings.

When peace shall come and her merchants take up the task of restoring Germany's ruined commerce they will find that it is a strang world which they seek to reenter. There will be difficulties in the path of future peaceful penetration of which they seem not to dream. Commercial frightfulness, like its military namesake, will have passed away. The monopolies on which German foreign commerce in large part seemed to rest secure have gone. Our friends beyond the sea and we ourselves have learned the danger of having our industries wholly dependent on foreign sources of supply which may become unfriendly. Goods that are cheap are not wisely bought if in so doing we incur the danger of foreign control of necessary supplies. It is pitiful to read that some Germans expect to take up the task of rebuilding their commerce where they laid it down. They reckon the world's demand for potash as a purely German asset. It was so but it is so no longer. They were the world's source for dyestuffs. That condition has gone. It was they to whom the world looked for optical glass. We do not look there now. They were the source of supply of chemical porcelain. We make it to-day as well as they. They had applied science to industry more than any other people and had built up industrial power by means others had neglected. We are learning that lesson also. There is much yet to learn but science speaks to our industry to-day with an authority which we did not recognize, which we are increasingly glad to accept, and which we shall not set aside. German commercial procedure was cunning and skillful. She was a competitor and also in no small degree the source of supply of those with whom she competed. As we look back the world seems to have been industrially asleep while with cunning skill she pushed alike into the markets in which we sold and into our centers of production so that often using materials "made in Germany" we had to compete in the world's markets with German products. We have awakened to these facts.

WAR HAS WAKED US—WE MUST STAY AWAKE

The war has waked us effectually. We have done what few dreamed we could do. The financial revolution in this country has been so rapid and far-reaching that it takes a constant effort of the mind to keep up with it. To swing from a debtor to a creditor nation in two and a half years, to pay off our funded debt abroad in masses of hundreds of millions, to cancel our floating debt to Europe, to turn about and loan abroad thousands of millions, to make foreign national and municipal loans commonplaces in our fiscal centers, to place American banks and American investments in many foreign places—all this is more like a golden dream than a sober reality. Yet these are the things which have been going on among us.

As it will be a strange world upon which the German merchant will look out when war shall close, so it will be in a large measure a strange world upon which the American merchant will look out at the same time. When embargoes are over and trading with the enemy acts shall have ceased to trouble, we also shall see things differently. The novelty will not arise with us from separation but the reverse. We have gained by contact a better understanding of the world. Scales of provincialism have fallen from our eyes. When our sons have fought and died together with those of Great Britain, France, Italy and the other nations associated with us in the war, things cannot be as they were before this happened. Each knows the other better. Old lines of separation have gone. Our vision is enlarged. Things strange have become familiar. Applied to commerce this means that we understand other peoples and their needs better and know better what and how to supply them. We have come into a family relationship, near and helpful to all concerned.

We shall also face that period with new power. We are learning thrift. We are giving the chemists and the men of other sciences their proper places. We are using resources long unused. Our men with vision are reaching out into all lands. The physical and financial tools of commerce which we have lacked are ready to our hand. The day of isolation is gone. We are in the family whether we will or not, and we shall draw richly from the family intercourse.

OUR HAND IS TO THE PLOW, WE CANNOT TURN BACK

We begin to learn something of the need and the way of stopping waste. We must learn more, for to the extent we waste—be it of food or effort or money—we shall be the less able to do our part in coming days. To talk "business as usual" where nothing else is usual, is hardly wise. There will not lack enough for all to do of necessary work while the war lasts. To do that which is unnecessary, to spend for that which is not required, is to diminish the power of the nation to do its necessary part. Waste and weakness go hand in hand—twin sisters of poverty—and it is both waste and weakness now to spend or do the unnecessary when the country asks all for effort and service in necessary work. We have raised great loans. Other loans will come and we must save for them. Our hand is to the plow and there can be no turning back till the furrow is plowed to the end. Yet herein lies the nation's hope in that it shall be able through the self-sacrifices of its people to do its work well to-day and to be prepared for the work of to-morrow. In this we may well admire and follow the wonderful thrift of our friends, the French, the splendid support of the people given by Great Britain to their Government, and the devotion that the nations acting with us have shown to the common cause.

I need not emphasize the commercial value of what we call "good will" or point the advantage of doing business as " a going concern." The great markets of the world have been and are to be found among the nations who have to-day parted company with Germany. The peoples of these lands are not likely to turn by one common impulse to Germany to renew the commerce broken by her act. The threads of intercourse have been cut. It is idle to speak as if all required were to pick up those threads and weave anew the commercial fabric. It will not be easily done. The conditions are not the same. The business sundered by the war is not "a going concern." It must be renewed under circumstances of peculiar hardship.

Controlling minds in Germany know perfectly well what separation from the world of commerce for over three years means. They had no intention it should be so long. They would hardly have ventured on the struggle had they dreamed it would be three years. A memorandum officially attached to the German Naval Bill of 1900 said:

> An unsuccessful naval war of the duration of even only a year would destroy Germany's sea trade and would thereby bring about the most disastrous conditions. . . .
>
> The destruction of our sea trade during the war could not, even at the close of it, be made good within measurable time, and would thus add to the sacrifices of the war a serious economic depression.

In What Special Ways Can the Industries Help?

How may our manufacturers aid the country now? They have not delayed help until to-day. In many practical ways our industries have been aiding their Government since long before the war began. In what special ways, however, can the industries further bring aid to the mighty task we have in hand? First of all then let us visualize, if we may, that task itself. We enter it in the spirit of seeing it through to the end whenever that end shall be and whatever we may be called upon to give to bring about that end. We entertain no delusions as to the power or the ability of our enemy. We mean to exert ourselves as if the task were ours alone to do. Slow to enter the fight we shall be equally slow to leave it until the high ideal which we seek shall be wrought into living fact. We expect it to take sacrifice of life, of money, of many cherished things, but the evil that threatens all free peoples must be cast out, cost what it may. Let no one, therefore, think that an exhausted foe confronts us or that we can afford to do less than our utmost in the fight that is on. The war will call for our best and we must be prepared to give it. The giving may have to be done patiently, steadily for a long time. We do not know for how long. But there must be no relaxing, no hesitation. We must tread the thorny road to the very end.

It fell to my part a few days since to speak frankly to a labor leader. I told him that in his trade as in others the fullest production of every man was needed for the nation's use and the man who for personal reasons left his work or delayed his product was striking a blow at his own family and at his own country. I said to him that the conditions were such that the absence of the product that the man might make, but did not, might in the end be felt by his own wife and children and that the nation at large called on him as a patriotic duty to keep work going. But my friend, the labor leader, reminded me with truth and emphasis that there were two sides to that question and assured me that while he and his fellows would do their full share, both they and the country had a right to expect that the employer would be equally self-restrained and far-seeing. So now let me frankly say to you as was said to him—*this is no time to rake over burning fires, let the ashes cool and go out.* There have been men in the ranks of labor who have not understood perhaps all that the country has a right to expect of them now. There have been men in the ranks of employers who have done likewise.

Produce! Produce! For Your Country's Sake, Produce!

To-day in every labor council the word should be—produce, for the nation calls its sons to be producers. To-day in every textile mill, in every paper mill, in every machine shop the thought should be from top to bottom produce, produce, for your Country's sake produce. To-day in every factory office the spirit of team work should prevail. We need every resource but most of all we need that men of light and leading in our factories shall recall that their employees and themselves are vital factors in the war. The vision of the country's need should never be lost to sight and the country's call should be heard in every corner of every mill and mine, in shop and office, saying to all "serve together."

Therefore I urge upon manufacturers to accept the high privilege of human leadership. You are in touch with men and with the power of men to produce and to save. Their savings are needed. Their production is needed. The men are needed. You, their leaders, have it in your power by self-forgetfulness and by far-vision to so lead the mighty forces you guide as to guarantee the result. In practice, therefore, there should now be no disturbances of labor standards, no suggestion of altered hours. Let these things rest while the nation itself calls. Keep the standards of living untouched and the standard of friendly leadership exalted. If the nation's need arises, you will be told what is required. Till that call shall come, let there be no undue pressure upon labor and let no advantage be taken whether for profit or for pride or for supposed principle of the hour of the nation's trial. Nay, it is true that since the ranks of labor must contribute their share to the forces of the field as well as of the factory, and must bear as they may the enhanced costs of food and other things, so far as possible labor should be made to bear less rather than more burdens, and the fine example of great industries in this respect may well be followed.

We Must Have a Low Cost of Production

I have said nothing about labor readjustments. If these shall come it ought to be remembered that what we need is not a low rate of wages but a low cost of production. The low wage does not always mean the low cost. Often the reverse is true. Here too is a test of character and capacity for all concerned. How far, how clearly can we see? Shall we think the problem through and act with matured wisdom or shall we be found wanting as those who cannot see the essential factors in production?

Looking back over a long business life for some clear statement of sound principle three brief phrases have occurred to me, which as they are looked at from different angles seem so clear, so proven, as to be worth stating. These are—Get facts; look far; think through.

In these six words lie packed masses of worldly and of spiritual wisdom. They are easy words to say but the processes they represent are most difficult to do. They involve abandonment of mental habits, the forsaking of preconceived ideas, the rejection of many current doctrines, the assertion of individuality, the restraint from hasty conclusions, the formation of unwonted habits; they call for effort, training, and long practice.

I think it is true that no man has ever succeeded largely in the business world without having all three of these principles present in his work to some degree. On the other hand, the presence of one or another of them without the rest often works serious damage.

Apply the Principle of Getting Facts

First, then, get facts. If we apply this principle as a measure to the business world we shall soon see that the men who live up to this principle are relatively few and lonely, and that most of us deal to a greater or less extent with fancies or with fallacies which we hope or believe are facts. Few of us will go so far in practice as the man who said to me, "If I don't know why I know what I think I know, then I want to know." Most of us are content with assumptions and few follow the scriptural maxim to prove all things and to hold fast that which is good. Yet facts, as has been well said, are stubborn things, and you may make up your mind now that if during your business lives you do not get the facts, the facts will get you.

To get facts, then, is fundamental. With them you stand on solid ground. Without them or with them but partially your footing is uncertain. You must have a docile mind, however, if you are to follow this rule, a mind open to truth, even to unpleasant truth, even to truth which sets awry that which you have believed and been taught. Yet the strong man sets his mind four-square to the truth and abhors that particularly villainous form of falsehood which tells but half of it.

BREAK OF THE DAWN OF THE DAY OF COÖPERATION

Finally, there emerges as perhaps the most important present contribution to our progress out of the new order, the dawning day of coöperation among us. Long we worshipped on the shrine of competition. But competition in its worst and unrestricted phases is a false god, a devourer of things economic, a creator of monopoly. It is the cruel law of the survival of the strongest. It is the lex talionis of the business world. In its pure form competition means that "he shall take who has the power, and he shall keep who can." The path of competition is spread with industrial and human wrecks. From it we reacted into combination, to the opposite extreme, out from the frying pan into the fire, led by the ignis fatuus of fancied profits. Great combinations grew, often contrary to economic law, and so visibly abusive of the rights of the business and the consuming world, that statutes completed the destruction which economics had in process. The combination left to its unrestricted self is as false in theory and bad in practice as cold competition was cruel.

Do not be afraid of facts, for they have no fear of you. If you have them with you you are safe. Without them you are always in danger. Know your job. Don't merely think you know it.

Apply the Principle of Looking Far

If you look far you will see beyond a whole mass of current phrases and ideas. These are the outward and visible expressions of average minds but across them he who looks far sees clearly a more distant and more fruitful horizon. Nay, the very act of looking far will make facts precious to you, for the broad vision will bring them to your sight and make you value them.

Here is a new outlook. Your business and mine has taken on a new relation. It is no longer our business alone. It has a national and an international relation which it did not have before, and those relationships penetrate down to the very smallest retail traders in the land and their prosperity and future depend upon the far vision that we have acquired and upon the courage we have attained with which to act in accord with that vision.

Apply the Principle of Thinking Through

The business life will, if you treat it fairly, call forth your best. It will mean the search for truth. It will mean a broad and human philosophy. It will mean keen, incisive thought. All these are good. But your business is not to be your life. It is the means whereby you live, but your life is something else. To be absorbed in business so that you live for it is to be intellectually and spiritually maimed. One who does so is not a whole man but only part of what might be a complete man. Of course to gain has wonderful interest. It is fascinating to pit mind against mind, knowledge and acumen and reflection and energy against the similar powers in other men. It is a splendid and in the best form an ennobling part of life, but it is only a part. There is a certain shallow criticism among us, which does not get the facts and does not see far and does not think through, which would teach at times that business is sordid and its motto "An eye for an eye and a tooth for a tooth." Yet this land and others are full of the works of men who, after they have won in the business arena, have given their ideals play in enriching the towns which gave them birth or in which they live. Every such gift is a protest against the shallow cry that business is wholly sordid. Yet in saying this I have not given you even a glimpse of all the facts about it. There are today factories all over this land, thank God, who think through the problems of business with a far vision of the facts and who have grasped the ideal of service to and through those whom they employ and are holding up before them and to the world examples of leadership that make the business life stand on a level with all that is best in statesmanship and art and music and law and the ministry and the other great and productive professions.

Coöperation for Victory

The need of the hour in America is co-öperation. We must see that in the great contest there is one grand common interest. You will be called upon to accept leadership and direction in this common interest. It may be necessary that there shall be for a time some centralized guidance in some things so to focus and control the nation's forces that they shall bear most directly upon the points of danger. We know we may confidently look to the far-seeing men who guide the industries of the United States to accept leadership or to follow it in behalf of their country. It will be our duty in full collaboration with the men of affairs with whom it has been and is a pleasure to work, to see that the organization of the Government for the dread purposes of war is made efficient; that so far as may be, individual and corporate needs shall be thoroughly and justly learned and considered. It is not the wish of the Government that any manufacturer should be injured or that such opportunities as come to him along normal lines should be lost. It is simply the purpose of the Government to guide all the productive powers of the country into those lines which make for the greatest strength and efficiency.

How the U. S. Department of Labor is Helping to Win the War

By Hon. Louis F. Post

Assistant Secretary of Labor, U. S. A.

The Department of Labor is performing a great public service today in redistributing workmen and promoting industrial peace. This authoritative article tells how its employment service is bringing the right men to the right job, and how its mediation service is preventing strikes and shutdowns that would diminish production. Employers are beginning to understand how these acts help them, for the department is eager for fair dealing and friendly intercourse between employers and employees in industry.

Mr. Louis F. Post *has been Assistant Secretary of Labor since the establishment of the Department of Labor in 1913. He was a printer to begin with, educated as a lawyer, practiced his profession, served as an Assistant United States Attorney, but has given the greater part of his active business life to editorial work and public service. Since 1881 he has worked for economic reforms and for improvement in industrial conditions through the influence of his papers and his writings.*

THOUSANDS of American employers who are now called upon to coöperate with the Government in aid of its prosecution of the war, do not begin to realize the great importance to them of the Department of Labor. Yet at this crisis that Department is indispensable. They have only to use it intelligently, with the idea of getting into harmony with its fundamental purpose, as many progressive employers are doing, in order to appreciate it as an invaluable agency of the very public service in which they themselves are engaged.

The organic act of this Department was approved by President Taft as his official term closed; President Wilson appointed the first Secretary of Labor as his began. This juxtaposition was prophetic. In administering the Department every partisan interest has been subordinated to the obligation of impartial service. The Secretary of Labor has from the beginning held himself bound to render such service, and never more solicitously than now. Regardless of party or class, but in the interest of all the people of this country and for its defence in the world war into which we have been drawn, the Department is, with multiplied energy, now devoted to the public service of bringing workmen to employers on fair terms to both, and to promoting industrial peace throughout the whole industrial field.

INDUSTRIAL MANAGERS!

Do you know that the Department of Labor:

Registered 19,000 ship workers in ten days.

Solved the transportation problem in Norfolk, Va., last summer by supplying laborers.

Placed over 300,000 men in manufacturing employment last year.

Has registered 50,000 workmen in Porto Rico and could transport them to the mainland at once if ships were available.

Supplied at once, on request, a list of 52 competent inspectors for airplane fabrics.

Prevented a strike of 75,000 Pennsylvania coal miners just after war was declared.

Prevented, in a similar manner, a strike of 25,000 miners in Alabama.

Adjusted 323 labor controversies in war industries, between January 1, 1916, and October 25, 1917.

Has saved hundreds of thousands of dollars to business interests, and an incalculable sum to related interests and the public since its establishment in 1913.

THE REMEDY OF LABOR REDISTRIBUTION

Business men need not be told that scarcity of labor, a most unusual condition, is especially puzzling to employers at this time. Whether labor is *in fact* scarce, no one knows; and if full information were had today it would probably be useless in a month—so rapidly are industrial conditions changing. It is known, however, that employers in occupations essential to the prosecution of the war, are short of workers by the hundreds of thousands. On the other hand, it is equally certain that many workers—possibly hundreds of thousands also—are unemployed, and that many more are working at wages which do not yield a decent living in the face of present prices for the necessaries of life. The solution of our labor shortage problem, therefore, is not the impossible one of creating a labor supply where there is none, nor the unthinkable one of compelling some men to work for the profit of other men. It involves only the possible and reasonable, even if perplexing task of readjusting our actual supply of labor power to our altered demands for labor. Redistribution of labor is the answer to the employers' problem of labor shortage; and this spells fair play for the underpaid, and fairly paid work for the unemployed. Here is an employers' problem—a wage-workers' problem too—which the Department of Labor can solve and is solving.

When the farmers of the great grain belt that stretches from Texas to Canada feared the loss last summer of their crops from scarcity of harvest hands, the Department of Labor marshalled for them an army of harvesters, and not a bushel of grain was lost for lack of labor. When the Maine potato crop was in peril from expected lack of labor, the Department made an interchange with the corresponding department of Canada, under which, while both countries were served in the wheat harvest from the Dakotas to Saskatchewan, the potato farmers of Maine were supplied with all the extra help they needed. When the corn and cotton growers of the Imperial Valley were reported to need from 1500 to 2000 families experienced in raising and picking cotton, besides a great body of farm hands for gathering the corn crop, the Department of Labor helped them out to their reported satisfaction. When workers were needed on short call in the orchards and vineyards of western New York, the Department of Labor supplied them. Those instances do not concern manufacturers directly, but do concern the public interest, and are significant of possibilities in manufacturing and in agriculture.

THE DEPARTMENT HAS HELPED SHIPBUILDING AND CANTONMENT CONSTRUCTION

What the Department of Labor can do for non-agricultural employers is indicated by what it has done. Soon after our declaration of war the Shipping Board requisitioned this Department for ship workers, and within ten days the Department had registered approximately 19,000 skilled mechanics for shipbuilding work. Shipyards having government contracts have learned from experience that the United States Employment Service finds workmen for them; and not only this, but that the men it sends to them are qualified for the work. In connection with cantonment construction, thousands of skilled mechanics as well as unskilled laborers have been directed by the Department of Labor to other governmental agencies and their contractors. As those jobs are finished, the Department enrolls the workmen for employment elsewhere, and these enrollments have run far up into the scores of thousands. A difficulty of extreme importance in transportation service at Norfolk at a critical time exemplifies another phase of this service. It was so adjusted that the extra labor the Department procured for additional boat-sailings enabled the business houses at Norfolk to prevent an imminent loss of foodstuffs to the country. A comprehensive idea of the work of the Department of Labor in bringing workers to employers may be got from a glance at its employment statistics. When this service was begun in the Department of Commerce and Labor, before the Department of Labor had been carved out of that executive department, the number of workers reported as having been employed through its agency at the end of its second fiscal year, June 30, 1908, was 5008. The number varied in subsequent years only slightly until 1914-15. It was 4283 in 1910, 5176 in 1911, 5807 in 1912, 5025 in 1913, and 3368 in 1914. But the first full fiscal year of this service in the Department of Labor, and the two fiscal years following, show these statistics, in which, however, the immense harvest hand placements the Department has made since 1915, are not included:

	1915	1916	1917
Workers applied for.....	7,427	107,331	418,810
Applications for work...	90,119	184,132	413,649
Actually employed.......	11,871	75,156	283,799

BRINGING THE RIGHT MAN TO THE RIGHT JOB

A still better indication of the extent of the Department's public service in this respect may be had from a glance at the facilities it offers to employers and workers for bringing the right man to the right job. Through coöperation with the Post Office Department any worker or employer anywhere in the United States can apply by mail, through his local post office or rural carrier, and free of cost, even of postage—the service is neither a free service nor a charity, but a public service absolutely—for the job he wants or the help he needs. His application is compared with others, first at the branch office to which it goes directly, then at the zone office if it survives the branch-office comparisons, and then at the central office at Washington if necessary. When these comparisons, in their order, result in matching a worker's application with an employer's application, steps are promptly taken to bring the applicants together in an employment engagement. This is the method for utilizing the mails. But it is not the only procedure under this public service. Every branch office and every zone office is a station also for personal applications and personal intercourse between workers wanting jobs and employers needing help. The methods are as direct and as various as the circumstances require.

COÖPERATION WITH OTHER EMPLOYMENT AGENCIES

It is a further policy of the Department to foster coöperation with the public employment agencies of States and municipalities. The theory of this coöperative system is opposed to a national system in the imperial sense; it favors, on the contrary, a federated system in which the national organization links the others into a national network of public employment service, intensive through the interwoven State and municipal systems and extensive through the national scope of the Department of Labor. Incidentally it may be remarked that the scope is so extensive, both in theory and in fact, that at the present moment the Department of Labor could help out any legitimate shortage of labor by bringing 50,000 wage-working American citizens from Porto Rico to the mainland before summer, if two or three transport ships were available. It cannot now obtain transportation from any source, public or private, for even so few as 500 of those citizens who are ready to embark immediately.

The number of public employment offices already established by the Department of Labor is 100 in round figures. Spread over the country from ocean to ocean and from the northern to the southern boundary, and in ready intercommunication, they are in high degree effective in bringing employers and workmen together, and are growing more so. Of course, 100 employment offices are all too few for the whole United States. Great Britain has 2100. But our Department of Labor has been financially unable to make its system complete.

Its efficiency, however, has been much augmented by voluntary service in aid of its war-emergency work. The United States Public Service Reserve, for example, is organized under the jurisdiction of the Department of Labor for the purpose, primarily, of registering and classifying offers of public service. These offers were buried at first in the pigeon-holes of the various branches of the government to which they had been sent. They were subsequently gathered together by the Public Service Reserve into a registry to which reference may now be made by government officials and by any employers engaged in government work. The original collection is increased by thousands of names minutely classified as to qualifications for service. They identify men who have authorized the Public Service Reserve, whenever it learns of a need in public or private employment for service in the national interest of persons of their qualifications, to offer them an opportunity to assist. The applications are made expressly with a desire for "a practical opportunity in this war emergency to contribute personal service by doing work that will aid the general welfare." An indication of the public usefulness of this arm of the Department of Labor may be had from its response to a call for inspectors of airplane fabrics. It promptly furnished the names, addresses and qualifications of 52 competent persons willing to serve. Upon a request for a technical officer of peculiar training for an army purpose, the Reserve produced an applicant who was duly commissioned within 48 hours after the request. When the Rock Island Arsenal was in dire need of machinists, a reference to the registry of the Public Service Reserve disclosed a helpful supply; and in response to calls from the army and navy, cooks, blacksmiths, mechanics and engineers have been found for them through the same agency.

United States Boys' Working Reserve

Another organization of volunteers which is under the jurisdiction of the Department of Labor as part of its war-emergency equipment is the United States Boys' Working Reserve. Although not organized until two weeks after the war began, it now comprises forty-one State organizations, all under a national director responsible directly to the Department of Labor. Last summer it placed thousands of city boys upon farms for seasonal work; in the coming summer it will be able to supply an army of city boys of the boy-club type, ranging in age from 16 to 21 years, and sufficiently trained to make their work desirable for seasonal and other emergency purposes. Farmers were hesitant at first about using city "boys" for farm work, but their hesitation passed away as the Boys' Working Reserve boys were tried. They were found faithful to their responsibilities and competent for their tasks. Of the 2400 boys that Buffalo sent to outlying farms, less than three per cent. proved unsatisfactory. Of 662 that went out upon farms from Chicago, their employers certified that 559 had made capable farm helpers. They averaged 87½ days' work during the summer and earned $38,154.18 in addition to their board. A cotton crop of 1000 acres in Arizona was saved by boys, who thereby added $24,000 to their savings. The apple crop of an entire county in Pennsylvania was harvested by 48 boys who moved from orchard to orchard and camped in tents. And when a New Jersey glass and fruit-jar factory was crippled by the draft upon its labor supply by near-by munition plants, 30 boys averaging 19 years of age, who were sent from Washington under a Y. M. C. A. director, cleaned up a warehouse, put in bunks, camped there for four months, and broke all records at the plant in the production of fruit jars. They added $2500 to the savings banks deposits of Washington as one result of their wholesome vacation.

Mediation Service

Hand in hand with the Department of Labor's public employment service goes its mediation service. This service in behalf of industrial peace is quite as important as the employment service, to employers and to workers alike. More than to either is it so to the country at the present juncture. It aims in this war time at inducing both—not by power nor authority but by reason and persuasion—to suspend their traditional antipathies, to utilize their respective organizations for effecting and maintaining peace and good will among themselves, and thereby to unify the nation for the terrific struggle in which it is involved.

Extensive as this work of the Department of Labor is, and successful as it has been, employers as a class are probably quite in the dark about it. This is no indictment of them, but rather of the prevailing theory of what constitutes news. For instance, soon after the war began, 75,000 Pennsylvania coal miners were about to strike because living expenses had outrun their wages fixed at a time when the prices of coal at the mine as well as living costs at the stores were very much less. Had those 75,000 men gone on strike, the event would have been news of the first magnitude. But the Secretary mediated a settlement which prevented the strike, and the news fell in value almost to the level of a local paragraph.

That achievement of the Department of Labor is typical of the war work it has done. In Alabama 25,000 miners were on the verge of a strike when Secretary Wilson intervened and effected a reasonable adjustment. In Colorado a stubborn controversy was compromised through like intervention. Similar interventions have occurred with similar satisfactory results in a variety of vocations. They include tin-plate production, street-car operation, copper mining, lumbering, meat packing, railroad shops, building, fishing, ship-construction, long-shore work, freight handling, railroad clerical service and manufacturing. From the beginning of our war to the 25th of October, 1917, the number of controversies between employers and workers which the Department of Labor was called upon to mediate was 521. It had adjusted 323 and had 104 still in hand.

Since the creation of the Department this conciliation service has operated with increasing effectiveness and with a growing confidence on the part of employers and employees alike. The results may be glimpsed in this tabulation:

Periods	Labor Controversies		
	Unadjusted Number	Adjusted Number	Per cent.
March 4 to June 30, 1914	5	28	85
July 1, 1914, to June 30, 1915.	10	26	72
July 1, 1915, to June 30, 1916.	22	178	89
July 1, 1916, to June 30, 1917.	47	248	84
July 1, 1917, to Oct. 25, 1917.	35	208	85
Totals	119	688	85

Of the last two items in the "unadjusted" column 48 cases, and of the last two in the "adjusted" column 323, were war-time cases. The saving thus effected for employees in wages and for employers in conservation of their business interests, may be calculated in the hundreds of thousands of dollars. The saving to related interests and to the public in many ways, financial and otherwise, is incalculable.

Employers Are Beginning to Understand the Department

The small number of cases down to June 30, 1915—15 unadjusted and 54 adjusted—was due in some measure, of course, to the fact that the functions of the Department of Labor had not then become generally known; but in a large measure it was doubtless due to a prejudice among employers who regarded the Department as devoted exclusively to labor union interests. This mistaken feeling has worn away as employers who have come in contact with the Department have begun to realize that the Department is eager for fair dealing and friendly industrial intercourse between employers and all their workmen.

Secretary William B. Wilson

There is indeed no denial nor evasion by Secretary Wilson of the fact that the Department he administers originated in a fifty years' campaign by labor unions for an Executive department—one with a cabinet officer at its head—through which American wage-earning interests could be reasonably represented in the councils of our Republic. Nor does he forget his own wage-working career. It was as a child-laborer that he entered the industrial struggle—a boy of less than ten whose dinner "blickey" hit the railway tracks step by step as he trudged to his daily task at a coal mine. He became a miner while still a youth; and in early manhood a blacklisted miner (for nothing that any fair-minded American would condemn) working at any job he could get and could learn to do, from bark-peeling to type-setting. Then in succession he became the principal financial officer of one of the largest international labor organizations of the United States and Canada, a member of Congress for six years, four of them in the chairmanship of an important committee, and finally a member of the President's cabinet. Experience as a Pennsylvania farmer was thrown in by the way and still continues. During all this period he has been a labor unionist, and while out of official life an active one. In addition to these circumstances, which may have prejudiced the Department of Labor with employers already prejudiced against trade unions, is the fact that its organic act creates the Department in the interest of wage-earners.

But both by administrative conduct and by specific declaration, the Secretary of Labor is committed to the principle that there is no authority for developing for wage-earners any special privileges, and no implication in the law that the wage-earners in whose behalf the Department was created consist of such only as are associated together in unions. "It was created," says Secretary Wilson in his first annual report—and in equivalent terms in every subsequent annual report—"in the interest of all the wage-earners of the United States, whether organized or unorganized." In further explanation of his policy in this respect he proceeds in that first report: "While the Department of Labor sustains friendly relations with labor organizations, as in the interest of all wage-earners and of the general welfare it ought to do, nevertheless this attitude must not be exclusive. Similar relations with unorganized wage-earners, and also with employers and their organizations to the extent to which they themselves permit, are likewise a duty of the Department;" and "in the execution of that purpose," he continues, "the element of fairness to every interest is of equal importance, and the Department has in fact made fairness between wage-earner and wage-earner, between wage-earner and employer, between employee and employer, and between each and the public as a whole, the supreme motive and purpose of its activities." As he says in a later report, the Department's authority contemplates diplomatic duties analogous to those of the Department of State. "As it is the duty of the Department of State to represent our nation with fairness toward all other nations, so it is the duty of the Department of Labor to represent wage-earning interests with fairness toward all other industrial interests."

The sincerity of those declarations has been demonstrated to the satisfaction of all employing interests and of all wage-earning interests that have in fairness and sincerity sought the aid of the Department of Labor, whether in labor distribution for the common good or in the promotion of industrial peace on the basis of industrial justice.

Efficiency Opposed to Prodigality

By Robert Mawson

Partner, Mawson Brothers

IN these days of high-speed production which is the desire of all wide-awake coöperating employees to obtain the largest possible output in the factory where they work. This thought is behind all modern methods of manufacturing and the application of every labor-saving machine. But the high efficiency aimed at is not a natural one; it does not come of itself; it must be worked for and worked for hard.

An instructive comparison is seen in nature. The vegetation of the earth grows and produces in profusion, but alas, how much is wasted! Yet in spite of all this prodigality nature does not produce nearly as much product of use to mankind from a given amount of land as it is possible to get with scientific farming. Fruit trees under wild or ordinary conditions bear only a small quantity of an inferior quauity, but pruning, grafting and cultivation—scientific methods—help nature to yield in abundance.

To gain our needed output in shop and factory a similar procedure must be followed. Wastes of all kinds must be checked. And the plant and employees must work under conditions that will give the maximum return with a minimum of effort. The point that I particularly wish to emphasize in regard to ordinary factory conditions is the similarity to the unorganized methods of nature. Nature is prodigal but inefficient, and so are far too many shops. As efficiency cannot be attained in nature through any process of growth, but must be introduced by man, so human effort through hard work must be applied to the shop to get rid of the haphazard and rule-of-thumb ways.

Machine-Shop Operations

If we turn to the machine shop for our example we must begin with the shop buildings themselves. These are the greatest tool of production. They must be planned and organized to help turn out product, not to hinder. The machine tools must be of a kind adapted to the work to be done, kept in first class condition and supplied with something needful in the way of auxiliary equipment and tools, and operated with the greatest effectiveness. Small parts of equipment must be carefully looked after as the arbor presses, vises, tool grinders and the like.

Then an analysis must be made of the machine operations. If it is found that most of the milling operations can best be performed before the drilling and lathe work then the milling machines should be in such a position that when the rough stock enters the shop it comes to them first. There must be no "back stepping." And then the other machines used in the sequence of operations must be so placed in reference to the milling machines that the work passes along in a regular unbroken series.

Routing and What It Does

Another means of increasing the efficiency that is too often neglected in the smaller shops is proper routing. Here is a powerful weapon to fight waste. Too often it will be found that on one class of machine tools there is a superabundance of work while others are idle. No such conditioin should ever be allowed to arise. Days before, even weeks before, the work, should be studied, planned, laid out and assigned so that the machine will have something to do all of the time. No machines should be over busy in operating at night while other machines are lying idle.

A factor in this routing is the supply of special and small tools. These should always be kept in safe, organized storage unless in use. When a job is about to be started they should be delivered to the machine along with the work and instructions, so that everything can go forward in an orderly manner.

Influence of Shop Surroundings

Another cause of wastefulness is in connection with the employees. To many readers they may be thought to be an unchangeable factor; but such is not the case.

Many are more influential and controlled by the environment in which they work than most of us realize. If a shop is run in a loose, careless manner, how can we expect the work to go forward except in the same way?

An interesting example came to my notice a short time ago which shows plainly the difference in men when working systematically and under the more common, haphazard conditions. Two men, who were as nearly as could be ascertained equal in skill and ability, were placed on similar work. One started very carefully planning every move and made every motion count. The other made quite a "splash," stirred up everything around him and added considerably to the machine-shop noise in his particular corner. Much of his time was spent in turning over this and that, searching for special tools that had been lost or misplaced. The results showed finally in the amounts of their production; for the first man proved to be a highly efficient workman and the other was inefficient.

Perhaps it is not inapt to say that the first man resembled the high-speed, modern turbine which drives the vessel through the water at a speed of 28 to 30 knots, and does it noiselessly but efficiently. While the latter workman can be compared to the small donkey engine on the same vessel which is always noisy, often balky and though it does its work, to be sure, does it inefficiently.

So efficiency must be worked for. It does not come of itself and it is opposed to wastefulness and prodigality.

The Business Machine at Washington

The War Organization Has Three Groups—for Purchasing, to Direct Industrial Policy, to Deal with Labor

By Howard E. Coffin

Chairman, Aircraft Board; Member, Council of National Defense

Many a business man is confused and uncertain when he wishes to do business with the government in these days of war. As a direct aid to him the author presents in this article the main features of the present government war machine from the business standpoint.

Mr. Howard Coffin *is a member of the civilian Advisory Commission of the Council of National Defense, and is also Chairman of the Aircraft Board. During the year preceding the outbreak of the war he was Chairman of the Industrial Preparedness Committee of the Naval Consulting Board and planned and put into effect the pre-war inventory of the industrial resources of the United States. Thus he has been in more intimate contact with our industrial preparations for war than any other man in the United States. In private life* Mr. Coffin *is one of our best known automobile engineers, having been chief engineer for a number of prominent motor car builders and, since January, 1910, consulting engineer and Vice-President of the Hudson Motor Car Company.*

THE tremendous expansion of government activity which the war has brought forth, reaching out and touching industry in almost every village of the United States, is nowhere better illustrated than in the number of people who daily storm the doors of the principal government offices to confer with officials on one business matter or another. It has been estimated that in two or three of the buildings where the largest amount of business detail is attended to, such as those that house the War Department and the Council of National Defense, a thousand or more visitors a day have to be taken care of and referred to the proper representative for the transaction of their particular business.

It is not strange that these visitors, many of whom are entire strangers to Washington and to the ways of the government, have difficulty in determining and finding the man qualified to attend conclusively to their wants. Frequently, in the past few months, men with important errands have been compelled through lack of proper information to travel to three or four different buildings before they found the right office for their purpose. Such cases are happily growing more and more rare, but it is still somewhat confusing to the first visitor to be confronted with the necessity of choosing among several branches of the government, each apparently having some connection with the business on which he is engaged. His troubles are augmented by the difficulties in getting a prompt hearing from men literally swamped with a constant influx of important engagements, and by the dearth of office facilities, which has compelled many important government organizations to divide their forces among several buildings in more or less widely separated districts of the city. The problem is equally difficult for the business man who attempts to transact his affairs by mail, and who is at a loss where to address his query among the rapidly growing number of emergency war agencies which have sprung up of late in the Capital. Even the permanent resident of Washington is constantly compelled to revise his mental Baedeker in order to keep in accurate touch with the new agencies with new functions which the war has developed.

Yet when the situation is examined with a little care, much of the apparent confusion is cleared away and it can be seen that the new agencies have grown up as a result of real need and that they fit in more or less naturally with the general scheme. The general basis of the war organization remains the same as that in force in the days of peace; the additions are almost wholly supplementary. The reply of the average business man to this will probably be that he was wholly unfamiliar with the government organization in peace time, so an article outlining the main features of the present government war machine from the business standpoint may prove both timely and useful.

Government Branches that Deal With Contracts

For the contracting engineer and the business man the chief interest naturally centers about the branches of the government that deal with the details of contracts. Yet there are so many other government agencies which touch closely the heart of the business fabric, agencies not primarily concerned in negotiating contracts but yet necessarily involved sooner or later in the carrying out of those contracts, or agencies whose policy will eventually influence all branches of industry whether they are holding government contracts or not, that a comprehensive outline of business and commercial Washington cannot be given without extending its field beyond the mere contracting organizations.

As an example of what I have in mind, many inquiries have been reaching different offices of the government of late as to the trend of the government's priority policy, in what way different forms of business will be affected by the gradual transformation of industry from peace to war work. Frequently these inquiries have been addressed to officials who have been in no way directly concerned with the development of that policy. It may be difficult indeed for the man at a distance, who is not familiar with the strenuous developments of the past few months from first-hand contact, to discover to whom he should send such inquiries. There are many such broad questions as this, in which almost every citizen will sooner or later be interested, whose answer might be found in a determination of policy by one or more government agencies entirely outside the government contracting organizations proper.

To outline the present system for the benefit of the business man who wishes to get in brief form an explanation of the main agencies which affect industry, both by active participation in the making and carrying out of contracts and by the determination of general commercial and industrial policy, it may be well to divide the government organization roughly under three main heads which will later be dealt with separately: 1. Actual purchasing agencies; 2. Agencies which touch general commercial and industrial policy; 3. Agencies which deal with labor policy. It will readily be understood that in so rought a division of functions due allowance must be made for overlapping, and that frequently one agency must be discussed in connection with more than one of the groups named. This grouping will serve, however, for purposes of examination.

The Purchasing Agencies

In the first of the three groups, the purchasing agencies, it is perhaps not commonly understood that at least nine separate and distinct organizations are authorized to contract for supplies, and their responsible heads are answerable to the government for the funds so employed. Of these nine, five are bureaus of the War Department. The other four are: the Emergency Fleet Corporation, which is in charge of the government's shipping construction; the Bureau of Supplies and Accounts of the Navy Department, in which the Navy's purchasing is centred; the purchasing division of the Marine Corps; and finally the Purchasing Department of the Panama Canal.

The five bureaus of the War Department ordinarily in the market for munitions of one kind or another are the Ordnance Department, the Quartermaster Department, the Signal Corps, the Engineering Corps and the Surgeon-General's department. While the head of each one of these bureaus is responsible to the Secretary of War, on him primarily devolves the function of directing the appropriation authorized for his particular agency, and he has under act of Congress complete statutory authority for negotiating contracts within his special field.

Each of these bodies has its own contracting officers, its own accounting force and its own field organization, augmented in every case by many recruits from civilian life Furthermore, as a result of the rush of work in the early days of the war, it was found necessary in a few instances to subdivide the functions of certain of these bureaus. As an example, in the Quartermaster Department, it was early realized that the task of building the new army cantonments was almost colossal, demanding in itself the efforts of a distinct division. The officer delegated to the work was separated from the rest of the department and built up a distinct organization adequate to handle the task, thus virtually creating a ninth purchasing division.

Difficulties of the Old System

Two obvious difficulties arose from this situation before the war was many hours old. The first was that the sudden and unprecedented demand for munitions of all kinds and the material for making them, especially if announced as in peace times by open advertising for bids from all the departments, threatened a dangerous and uneconomic competition and a consequent dangerous inflation in prices. The second was that in many instances each department stood in urgent need of the same munitions, and particularly of the same raw materials. The Navy and the Shipping Board both needed structural steel. The Ordnance Department and the Signal Corps both needed machine guns—the former for infantry, the latter for airplanes. The Signal Corps and the Quartermaster Corps were soon both interested in the building of cantonments, the former for aviation fields, the latter for training camps, not to speak of other construction projects in which many departments were concerned. The number of instances can be extended almost infinitely. No matter how eager the departments might be to coöperate with each other, and too high praise cannot be given the spirit with which they met the situation, no conscientious official could fail to feel that his own department's interests at the moment were paramount.

It is here that the Council of National Defense and its supplementary organization enters the story. Created to mobilize the industries of the country for the national defense and to make easily available to the government in time of need the services of the nation's professional and industrial intelligence, the Council, with the coöperation of the regular departments, set up an auxiliary industrial machine to assist in solving these difficult problems. The urgency of the need and the success with which it has met it is perhaps best illustrated by the manner in which the Council's organization has expanded, until its force now numbers hundreds of men, directed by a group which includes some of the best known names in American business life. Aside from numerous other important functions lying somewhat outside the scope of this article, it has established a clearing-house for the munition needs of the several departments and their subordinate bureaus, so as to assist in determining both price and priority in accordance with the needs of the government as a whole instead of leaving these questions entirely to the judgment of the several individual agencies themselves. The regular contracting agencies have nowhere been supplanted. In every case they are functioning as before, with their organizations intact—greatly expanded in almost every instance, usually by putting civilian experts in uniform—but the final decision on contracts in every case rests with the government officer responsible under statute for the disposition of his appropriation.

The War Industries Board

Without going into the history of this development, which space forbids, the present organization so far as it relates to contracts may be briefly described as follows. The general supervisory direction of purchases, including the development of additional sources of supply, rests with the War Industries Board of the Council of National Defense, which has as its civilian chairman Daniel Willard, President of the Baltimore and Ohio Railroad, and Chairman of the Advisory Commission of the Council. Colonel Palmer E. Pierce represents the Army on the Board, and Admiral Frank F. Fletcher the Navy. There are four other civilian members, Messrs. Bernard M. Baruch, Robert S. Brookings, Robert S. Lovett, and Hugh Frayne, the last-named representing labor. Messrs. Baruch, Brookings and Lovett form an inner "Committee on arranging purchases," the first having special charge of raw materials, the second of finished products, and the third of questions of priority. Each of the three has an extensive supplementary organization under him composed of specialists in the various industrial fields covered by his branch of the work. Judge Lovett, whose task of determining the relative importance of various forms of munitions and the raw materials which are used in their manufacture is perhaps expanding as rapidly as any branch of war work at the capital, is also, by appointment of the President, administrator of the Priority Shipments Act recently passed by Congress, and is thus in a position to secure the closest coördination between priority in filling orders and priority in shipment. The executive secretary of the War Industries Board is Lieutenant H. P. Bingham.

The Clearance Committee

Aside from the divisions of the Board already mentioned, one of its most important committees is the Clearance Committee, which considers the placing of orders or contracts by the various departments desiring to purchase materials designated in the list showing that a shortage exists or is imminent. The Chairman of this committee is Captain C. C. Bolton. Its duties are to consider the price and source of supply involved in cases of contemplated purchase involving limited amounts, and to avoid any obvious conflict in the supply of the same material for several departments. It approves the placing of minor orders or contracts as recommended by the department concerned when fully satisfied of the propriety of the action desired. If matters of priority between the departments represented in the committee can be adjusted by the committee, it is so recommended to the Priorities Division. If matters of price cannot be approved unanimously, the matter is referred to the Division concerned. It refers to the Raw Materials or Finished Products Division of the Board, as the case may demand, such items of shortage as it discovers, to secure an increased supply of the item, or to develop a satisfactory substitute.

Functions of War Industries Board

In general, the functions of the War Industries Board may be described as those of a clearing-house for the war industry needs of the Government. It determines the most effective ways of meeting them, including recommending methods of increasing production, the extension of industries demanded by emergencies, the sequence and relative urgency of the needs of the different Government services, considers the price factors, and, in the first instance, the industrial and labor aspects of the problems involved.

The several Government Departments, then, are as before continuing their organizations, with their chiefs responsible for all contracts, but they have available the constant assistance and advice of this big supplementary organization to prevent conflict of interest and to aid them in getting munitions along sound industrial lines with their needs treated as a whole, not separately. The field which the War Industries Board, with the General Munitions Board which it supplanted, has covered, ranges all the way from the procurement of pig iron and copper to securing motor trucks and finished uniforms. It has also included material asssitance in the building of cantonments, through the establishment of an advisory "Emergency Construction Committee."

In the case of airplanes, supervisory work of the same general character has been performed by the Aircraft Production Board of the Council, which is now being reorganized under a recent act of Congress as the Aircraft Board, to act jointly for the Signal Corps of the Army and for the Navy. Attention is given, of course, to seeing that the proper coördination with the work of the War Industries Board is secured.

Agencies Controlling Commercial and Industrial Policy

In the second group of agencies which affect the government's commercial and industrial policy to a greater or less extent, although they are not directly concerned in the letting of contracts, and some of them do not come in direct contact with industry, may be included a wide range of organizations, a large part of them creations of the war situation. Aside from the Department of Commerce, and the Federal Trade Commission, the following important agencies may be mentioned: the War Trade Board, the Food Administration, the Fuel Administration, the Committee on Transportation of the Council of National Defense (with the Railroads' War Board), and the Commercial Economy Board of the Council of National Defense. It might not be amiss to include in this group also the Priorities Division of the War Industries Board, in view of the very pronounced indirect influence on industry of its determination of priority in materials in effecting a gradual tranferrence of business from non-essentials to war work.

The functions of some of these agencies are too well known to require comment in an article of this character. In connection with the Federal Trade Commission, however, it should be pointed out that in addition to its ordinary peace time functions, through its power of investigation it has exerted a very marked influence on the determination of war prices through determination of costs at the direction of the President. With the approval of the President these findings have been made available to the War Industries Board for joint conference in arriving at a final decision on a price adjudged satisfactory alike to the government, the public and the industries affected.

The War Trade Board, of which Mr. Vance McCormick is Chairman, derives its power from the Espionage Act, the Trading with the Enemy Act, and three executive orders of the President. It sits daily, deciding on questions of policy with regard chiefly to foreign trade, and negotiates with foreign governments. It is charged with the enforcement of the authority covering the control of exports and imports conferred by the Espionage and Trading with the Enemy acts. The President has issued proclamations governing the restrictions of exports and imports and providing a system of licenses. The War Trade Board has instructed shippers concerning the licenses, and is directly in contact with American business as it relates to foreign trade. Only with the consent of the Board may agents of the enemy countries do business in the United States. Enemy companies also may not change the names they used at the beginning of the war without special license. It has the executive administration of all instructions issued by the President regarding exports and embargoes, and, in conjunction with the War Trade Council, is engaged in conserving the food supply of the country and regulating exports so that the products of America will not reach the enemy.

As an advisory body to the War Trade Board, an executive order of October 14, 1917, created a War Trade Council, consisting of the Secretary of State, the Secretary of Agriculture, the Secretary of Commerce, the Secretary of the Treasury, the Chairman of the Shipping Board and the Food Administrator. The immediate work of issuing, refusing, withholding and revoking of licenses is carried out by a Bureau of Exports, which follows the instructions of the War Trade Board.

Food and Fuel Administration

Of the Food Administration it is hardly necessary to speak as the character of its work is already so widely known, and as it touches only remotely the immediate purpose of this article. With the Fuel Administration, although its functions are already equally widely known probably, it may be well to point out in passing that the Fuel Administrator has plenary powers in the administration of the country's coal supply, and that in this way he can exert a very marked influence on industrial conditions. By exercising priority in the coal supply through its power to control distribution, not to speak of its many other vital functions, the policy of the Fuel Administration cannot fail to become of ever increasing importance in the course of American industrial life.

Railway War Board

The transportation facilities of the country as at present organized are very closely controlled and directed by the Railway War Board, composed of representative executive officials of leading railways of the country. Under coöperative agreement the Government is everywhere given preferential consideration in the movement of traffic, and through the pooling system recently developed, the railways have been even further mobilized under central control for war purposes. The control is exercised through the War Board and its subsidiary committees, organized at the request of the Council of National Defense and reporting to Mr. Danial Willard, the chairman of the Advisory Commission of the Council of National Defense, and chairman of the War Industries Board, who was given by the Council special charge of matters of transportation and communication. The War Board has an office building in Washington with a large staff to assist in carrying on its work. Under a somewhat similar arrangement the telephone and telegraph facilities of the country have also been placed voluntarily under the Government's general supervisoin.

Commercial Economy Board

Another subordinate organization of the Council of National Defense which should be mentioned in any account of agencies whose policy has a direct interest to commercial business is the Commercial Economy Board. In spite of a large amount of publicity which has been given the work of the board its functions are still apparently misunderstood in some quarters. The work of the Commercial Economy Board is to secure through the coöperation of business houses economy in the use of men and materials to aid in carrying on the war. It has given special attention to the task of assisting in limiting waste in retail deliveries including waste in the distribution of bread. It has also held conferences with woolen manufacturers on the problem of revising dress styles to assist in the conservation of wool. The general purpose underlying the board's work is to assist business men to conduct special phases of their work along more economical lines, permitting them to conduct their business with less men and equipment, thus enabling them more easily to meet the drain on man power which the war is expected to bring.

Agencies to Handle Labor Problems

No account of the war industrial organization at Washington would be complete without some description of the agencies which are being developed to handle the labor problem as emphasized by the war. Practically every department that has to do with industrial work either has developed or is developing some form of organization to deal with problems of adjustment and distribution on vital war work. Besides the Department of Labor which, of course, is primarily concerned with all labor problems, the following special agencies have been created within the last few months:

The War Emergency Section of Employment Service of the Department of Labor, created especially for war work: the head of this organization is Mr. Charles T. Clayton. It was created by the Secretary of Labor to investigate the labor needs in war industries and to concentrate the forces and resources of the Employment Service to meet those needs.

The Arsenal and Navy Yard's Wage Commission, established by the War and Navy Departments to pass on wage questions arising in arsenals and navy yards. Mr. Franklin D. Roosevelt, Assistant Secretary of the Navy, is chairman.

The Board of Control of Labor Standards in Army Clothing, established by the Secretary of War, not to adjust labor disputes in the garment industry but to prevent army contracts for clothing being let to contractors who employ "sweat" conditions. Mr. Louis E. Kirstein is chairman, and the headquarters of the Board are at 120 West 32nd street, New York City.

The Cantonment Adjustment Commission, established by the Secretary of War to settle all labor differences arising in construction of cantonments, aviation fields, and storage warehouses. General S. F. Ansell is chairman.

The Committee on Labor of the Council of National Defense, with its subordinate committees acting in special fields. This important committee is headed by Mr. Samuel Gompers, President of the American Federation of Labor and a member of the Advisory Commission of the Council of National Defense. Its main lines of activity have been to furnish advice in regard to the conservation and welfare of the workers in the nation's industries, and in regard to the means of adjustment of employment problems without interruption of industry. It includes at present fully five hundred members representing organized labor, employers and specialists in industrial economics.

The National Adjustment Commission, organized by the action of the Secretary of War, Secretary of Labor, United States Shipping Board, and Mr. Samuel Gompers. Its chairman is Mr. R. B. Stevens, vice-chairman of the United States Shipping Board. Its main lines of activity are the adjustment and control of wages, hours and conditions of labor in the loading and unloading of vessels on the Atlantic, Pacific and Gulf coasts. This commission is authorized to appoint at each important port a local adjustment Commission composed as follows: one member to represent the Shipping Board and War Department, one to represent the International Longshoremen's Association and nominated by the International Longshoremen's Association, one to represent the carriers in foreign trade and nominated by the Committee on Shipping of the Council of National Defense and to act only in cases involving foreign service, one nominated by the Committee on Ships of the Council of National Defense to represent carriers engaged in coastwise trade and to act only in cases involving coastwise trade. All differences which arise in any port are adjusted by the local commission if possible. In case either member is dissatisfied with the decision of the local commission it may appeal to the national commission for review. This arrangement does not apply to the Pacific coast where the employers have agreed that any dispute between the employers and employees not settled locally between themselves shall be referred to the National Adjustment Committee, whose decision shall be final, work to be continued pending the decision of the commission.

The President's Commission; this commission was created by action of the President to investigate labor conditions in mountain regions and on the Pacific Coast, and at the time this article is written is traveling through the western states. Its chairman is the Secretary of Labor.

The Saddlery Adjustment Commission was created by action of the Secretary of War, especially to prevent interruption of work in factories of contractors for harness and saddlery for the period of the war. Its chairman is Mr. Stanley King, Assistant to the Secretary of War.

The Ship Building Labor Adjustment Board, created by the action of the Secretary of the Navy, the United States Shipping Board, Mr. Samuel Gompers and other labor leaders, for the general adjustment of questions as to wages, hours, and conditions in ship building plants. Its chairman is Mr. V. Everit Macy, personal appointee of the President.

In addition to these organizations created to meet special needs, and informal groups which have been organized for various governmental branches to take care of special labor work in their particular fields, the Council of National Defense recently inaugurated a Section on Industrial Service, the functions of which were announced as follows:

1. To determine present and probable future demand for labor in war industries.
2. To determine in connection with the Priorities Committee of the War Industries Board the relative priorities of the labor demand.
3. To arrange for the supplying of the demand through the Department of Labor or such other governmental or civilian agencies as can best meet the demand.
4. To determine the needs for dilution of labor including the introduction of women into industry and recommend policies to be followed in regard thereto.

This work under the Council has been put under the immediate charge of Mr. L. C. Marshall.

The Importance of Organization Laws in This World Crisis

An Earnest Plea for the Study of Principles and Laws

By C. E. Knoeppel

The staggering immensity of our war problems, both now and after peace shall come, have so impressed the author that he almost begs industrial executives to study as never before the regulative principles and fundamental laws of organizing human activities. He suggests six such principles and practicalizes them in twelve laws.

Mr. C. E. Knoeppel, *founder and president of the firm of C. E. Knoeppel and Company, consulting industrial engineers, served through the shop as molder, draftsman and designer in the plants of several representative manufacturing firms. Later he became an expert systematizer. After specializing on analytical work in factory management he was in the employ of a number of industrial establishments, and was associated with three firms of industrial engineers. This experience led to the founding of the consulting organization that he now heads and directs.*

THIS war-stricken world of ours is going through an era of disillusionment; our eyes are being focused on bigger and better things. What was considered visionary before the war has today become practical; business is thinking in terms of service instead of in dollars; we have leaped into a realm which is putting men before things. All of which means that the war is not without its compensations.

In other words, *the world has awakened to the real value of Organization as never before.*

What do I mean by Organization? The proper adjustment and relationship of human beings.

In solving the staggering war problems confronting us and in answering the question—"After the War—What?"—any attempt to define Laws of Organization will be helpful to the student of this great, big question, the *organization of human activities.*

Let me outline briefly what these laws are:

First Law. Objective—Working up a tentative plan with reference to the ultimate development desired.

Second Law. Greatest complication—The determination of the most complicated phases of the objective.

Third Law. Concentration—Placing in each division of a business all of the factors which effect the performance of its own function.

Fourth Law. Individualism—Placing in the hands of one man, most competent to handle the work, one or more functions of a business.

Fifth Law. Mental Capacity—Dividing work in an organization, with reference to the knowledge and ability that will be required of a man in charge of one or more functions of a business.

Sixth Law. Specialization—Dividing work so that a man may operate in limited fields rather than cover many diversified fields, in order that a few things may be done well rather than a large number superficially.

Seventh Law. Responsibility—Holding a man responsible for the total proven results he secures in his division and not for the details or the methods that he uses in securing these results.

Eighth Law. Permanency—Training men to fill other positions than their own and providing for understudies so that changes in an organization may easily be made without disruption.

Ninth Law. Cross fertilization—Giving each pivotal man in an organization some opportunity during the year to know the methods of the departments his work influences mostly and of the departments which influence his work.

Tenth Law. Relationship and instruction—Providing a man with a clear-cut conception of the relationship existing between himself and those he is associated with, as well as with a written outline of duties, functions, responsibilities, results expected and methods affecting his work.

Eleventh Law. Personnel—Analyzing the requirements of given positions and finding men whose qualifications match the given requirements.

Twelfth Law. Staff and conferences—Creating an analytical and advisory body in an organization to coöperate with the executive, as well as a conference plan to make it difficult to determine where staff advice ends and line acceptance begins.

The above is, of course, a very brief outline of the laws of organization work, for a chapter could easily be written regarding each one, but it is felt that a study of the laws outlined will clear up many of the doubts regarding the matter of how to go about solving the reorganization problems of this critical era.

These laws are used to practicalize certain principles of organization:

First. Investigation—Analyzing industrial shortcomings.

Second. Coördination—Building the proper industrial machine.

Third. Records—Devising simple yet comprehensive cost, production and accounting records which executives can use as a real guide to results.

Fourth. Planning—Arranging for the efficient coördination of production details.

Fifth. Standardization—Determining correct shop practice, operation methods, costs.

Sixth. Incentives—Arranging for rewarding in proportion to interest, effort and coöperation expended.

In this great work of world reorganization, the greatest results will be secured by that nation, concern or individual which builds what it does on correct principle and law.

The above comments are not final by any means as there is no ultimate attainment in this world, but the step is in the right direction and it is the author's hope that in the coming year he may, in these pages, outline these laws in a more thorough and practical manner.

What I plead for now is a study of principle and law —the matter of application follows as a natural result.

Enter the "Balancing Engineer"

By N. W. Akimoff

THE necessity or balancing rotating machine parts seems to be taking root slowly but firmly in the minds of manufacturers. We still have the erroneous opinions of would-be practical experts, as for instance belief in the possibility of balancing one end of a piece at a time, or the idea that an unbalanced shaft may in time "limber itself into balance." (The latter opinion has been expressed in writing in defense of a condition where the shaft of a certain new motor car was so badly out of balance that it could not be used at all.) But in spite of these wrong ideas we are hearing less and less frequently that any old balancing method is just as good as the next one; or that a man must be born a balancer because that "innate sense of finding high spots" cannot be developed. Let us hope that in another year or so all these things will vanish and we will be in an era of rational treatment of this apparently elusive but in reality very simple balancing problem.

The writer's position has never been shifted from the standpoint adopted by him two or three years ago; dynamic balancing is not a shop process, but a separate branch of mechanical engineering. A mechanic, even if very capable, and whether a "born balancer" or not, can only handle a fraction of the problem; the rest must be attended to by an engineer. Let us now bless this individual with a special name, *balancing engineer,* and establish his responsibilities.

THE BALANCING DEPARTMENT

In a small plant the balancing department is usually a secluded corner where you will generally see but one machine. In a large plant, the equipment may be five or six machines, often installed in a special room and accompanied by other equipment such as drilling machines, grinders and the like used in correcting parts that are out of balance. As a rule the operators who are running these machines are excellent fellows, good workmen, conscientious and enthusiastic; but at the same time very ignorant of the real characteristics of the balancing problem. So the final results are negative or unsatisfactory. And why should they not be? These mechanics have never been educated to read the slide rule, to think of couples as vectors, to handle the problem of small oscillations. It is self-evident that it would take years for them to master these things and no one would wait for them.

WORK OF THE BALANCING EXPERT

Perhaps you ask what this expert has to do? Let us assume that the balancing department comprises four or six balancing machines. Each machine must have an operator, some doing static and others dynamic balancing. The problem in front of each one of these men is only to find the proper adjustment of the machine and make sure that it is satisfactory to the balancing engineer. The latter needs only a glance to see whether or not the reading has been found correctly; after this the interpretation of the reading, the fixing of the remedy to be introduced and the supervision of the correction is the responsibility of the engineer. Perhaps two minutes work with the slide rule gives the location, size and depth of the holes to be drilled. That is, it is safe to assume that some 12 to 15 crank shafts can go through the hands of such an engineer every hour without the slightest possibility of delay or slip-up of any kind. Perhaps some one will say that the balancing engineer is the foreman of such a department. And there is some reason for putting it that way.

To carry out the well recognized principles of the division of labor each operator must have only one thing to do. He must do static balancing, or dynamic balancing, or grinding for making corrections, or drilling for the same purpose. In case a man endeavors to do all of these operations on a shaft his output per day would be no more than eight or ten at the very most.

QUALIFICATIONS OF THE BALANCING ENGINEER

It must not be imagined, however, that any correspondence school graduate or even engineering graduate is necessarily qualified for the responsibilities of balancing engineer. A man of creative imagination and more or less freedom in handling theory is needed because of the multitude of problems that require an instantaneous and definite answer.

Any engineer who has enough character and persistency to thoroughly prepare himself on such subjects will soon find that there is ample demand for all that he can do. The practical "born balancer" is dead. Long live the entering balancing engineer!

The Problem of Artificial Lighting

How to Evaluate Lighting Costs as a Proportion of Wages

By C. E. Clewell

Factory lighting did not improve until industrial managers began to think of its economic value in relation to wages. Good practice now places the lighting cost factor at about one per cent. of the pay-roll. This article, in addition to giving the economic side of the problem, shows several typical factory lighting installations and helpfully points to the probable trend of future industrial lighting policy

Professor C. E. Clewell *is assistant professor of electrical engineering at the University of Pennsylvania Following his technical education at Lehigh, he was in the employ of the Westinghouse Electric and Manufacturing Company, and was one of the lighting experts of that firm. He left that work to undertake the teaching of electrical engineering in the Sheffield Scientific School at Yale, leaving there about three years ago to take up his present duties.* Professor Clewell *is an active member of the Illuminating Engineering Society, and was chairman of the Committee that drafted that Society's industrial lighting code.*

WITHIN the past seven or eight years the place taken by artificial light in the problem of effective management has been reduced to a fairly definite working basis. In a general way it is true that the necessity for some light has always been acknowledged as one of the prime factors in good workmanship, but in most cases this has been a generalized idea which has lacked the definite character of a scientific principle. This has been partly due to the fact that the distinction between merely good lighting and scientific lighting in itself has begun to be appreciated and understood only within the past few years.

In 1910 the idea was advanced that the costs of factory lighting can to advantage be equated to a percentage of the daily or annual wage expense. This was a new idea becuase it directed attention away from the electrical energy and maintenance costs for lighting merely as an expense pure and simple, and brought together the idea of lighting with that of production, thus emphasizing the hitherto generally overlooked idea that good light plays an important part in controlling output. Since 1910 it has become a common method, in expressing the advantages of good light in factory work, to evaluate the cost of lighting to the equivalent part of the wages for the purpose of determining the amount of time which, if saved by the presence of good light, will pay for the total expense of its operation.

Artificial light has thus become a definite factor in the problem of management and it is no longer necessary, therefore, to dwell upon the advantages of adequate light on a generalized basis. The main purpose of the persent article is to outline the fundamental aspects of the artificial factory lighting problem in its more definite relations to modern industrial management and to summarize the results of the past few years in placing the lighting problem upon a scientific basis in connection with industrial processes and methods.

Increased Value of Floor Space

In any factory building with a window equipment which furnishes sufficient daylight for the floor area relatively near the windows, but which does not properly light interior spaces more remote from the windows, the value of these interior spaces for manufacturing purposes is greatly reduced by the absence of suitable light. The addition of an artificial lighting system for properly lighting all parts of the floor space in such cases has the effect of definitely increasing the value of certain portions of the floor area.

Again, any factory which is properly equipped with windows for providing daylight conditions throughout, during all of the hours of the working day, if unequipped with an artificial lighting system is not in a condition to utilize its floors for night work. Under the assumption that the plant in question is of sufficient size to take care of all orders at the start, but a later increase in the volume of business makes it impossible to handle all of the work within the hours of a day-shift, two alternatives are faced.

Either the plant must be enlarged by new buildings or additions, which will require a construction expense, or an artificial lighting system must be installed in the original plant for the purpose of extendng the working period to a 24-hour basis per day. In the first case, the extension of the plant is contemplated with a limitation of work to a day-shift only; in the second case, the fixed charges on the first cost and the operating cost of a lighting system must be compared with the fixed charges on the expenditure for the new addition to the plant, and night work be given consideration.

Careful studies into this problem show that the cost of light is usually a good deal less than the fixed charges on a new building, or than the rental for additional space. Furthermore, with modern lamps and methods of lighting, the illumination conditions at night can be made practically as good as those from natural light by day, so that the old prejudice against night work due to poor light no longer holds in the modern plant.

Light and Wages

The evaluation of daily or annual lighting costs to the proportion of wages which constitute an equivalent value, has a two-fold purpose. First, this plan furnishes a convincing and convenient basis for sizing up the magnitude of lighting costs in terms of the more familiar wage expense item; and second, it makes possible the decision as to the value of plenty of light in its beneficial effect on production. The latter feature is usually accomplished by ascertaining the number of minutes per day which for the corresponding wages are equal to the lighting costs for the day. It follows, therefore, that if the given number of minutes are more than saved by the presence of good light, whereas they would be lost under inadequate light, the good light may be classed as a paying investment.

As a matter of fact, there is an additional reason for comparing the lighting costs and wages in this manner. In any plant where a good system of lighting is contemplated, as a substitute for an old and inadequate system, the first cost of the new equipment often stands in the way of prompt action on the part of the management. By showing that the probable time which can be saved due to the new and improved equipment will more than pay for the new system, the appeal to make the necessary outlay for new lamps and wiring is usually strong enough to bring about their adoption without further delay.

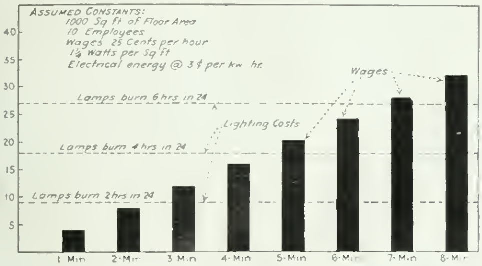


Fig. 1. THE SOLID SPACES REPRESENT THE WAGES FOR INTERVALS OF 1, 2, 3, ETC., MINUTES. THE ORDINATES OF THE HORIZONTAL DASH LINES REPRESENT THE COST PER DAY FOR LIGHTING THE AREA OF 1,000 SQ. FT. 2, 4 AND 6 HOURS RESPECTIVELY. Note, for example, that when the lamps are burned two hours per day, the cost for the light is paid for if between two and three minutes are saved by each workman per day due primarily to the lighting facilities.

Figure 1 shows graphically the total wage charges per 1,000 square feet of floor area in which 10 employees are stationed at a rate of 25 cents per hour. The solid areas indicate the wages for the 10 men for periods of one, two, three, up to eight minutes. The horizontal dash lines show the costs for light under different assumed numbers of hours service per day, and at a given assumed rate per kilowatt-hour for electrical energy. This diagram indicates that under the given conditions, the lighting cost for two hours per day service is equivalent to the wages for between two and three minutes per day; for four hours per day service, between four and five minutes per day wages; for six hours per day service, between six and seven minutes per day wages.

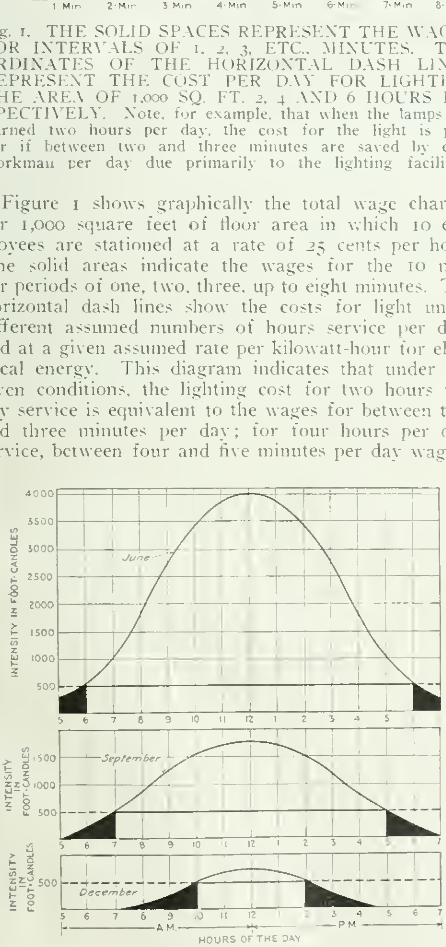


Fig. 2. THE LOWER CURVE SHOWS THAT FOR A GIVEN PRESCRIBED MINIMUM VALUE OF LIGHT FOR THE WORK; FOR GIVEN EXTERIOR DAYLIGHT CONDITIONS, AND FOR A GIVEN "DAYLIGHT FACTOR" ARTIFICIAL LIGHT WILL BE REQUIRED BEFORE 10 A. M. AND AFTER 2 P. M. ON AN AVERAGE DECEMBER DAY. The shaded areas of each of the other two curves represent the periods between 5 A. M. and 7 P. M. when artificial light is required in a building with the given conditions if the prescribed minimum is to be maintained at all times.

RELATION TO PRODUCTION

These relations show that any section with conditions corresponding to those in Figure 1, which is experiencing a loss of six or seven minutes in the entire day due to poor light, can readily afford to install a modern system of lamps and burn them six hours per day. Variations in the conditions will, of course, modify the degree of these conclusions to some extent, but it becomes a very simple and effective matter to work them out for any given plant when the conditions seem to warrant a change from poor to improved lighting.

It is very important to note the magnitude of the wage equivalents. Four to six minutes out of an eight-hour day means four to six minutes in 480 minutes, or roughly, one per cent. of the day. In poorly lighted sections, the actual losses of time, due to the inability to see properly, will usually reach values far in excess of these relatively small equivalents. Thus, the employees in a poorly lighted factory may not be able to start effective work on winter mornings for from one half to a full hour, or until the daylight conditions begin to reach satisfactory values for vision. Similar losses may easily occur toward the end of the day when the daylight begins to fall below satisfactory values in advance of the closing of the working day. Losses from these causes may readily be many times greater than the equivalent cost of light, thus making the argument for good light even stronger than a first glance at Figure 1 would indicate.

ARTIFICIAL LIGHT AND DAYLIGHT FACTOR

In Figure 2 the variations in the intensity of exterior illumination for average days in June, September and December are shown. These curves are based on tests in Great Britain. Taking these curves as a basis, let us assume that a given point within a factory has a constant daylight factor (ratio of interior to exterior illumination) of 0.6 per cent., and that the minimum value of the daylight intensity required for the work is three foot-candles. Under these conditions, it follows at once that the exterior illumination must have an intensity of at least 500 foot-candles to result in three foot-candles at the points within the building where the daylight factor is 0.6 per cent.

Hence a horizontal line drawn across each of these curves of Figure 2 at the point of 500 foot-candles, cuts the June curve at 6 a. m. and at 6 p. m.; the September curve at 7 a. m. and 5 p. m.; and the December curve at 10 a. m. and at 2 p. m. This brings about the rather startling conclusion that with the given daylight factor, the daylight conditions will be satisfactory from 6 a. m. to 6 p. m. on average June days; from 7 a. m. to 5 p. m. on average September days; and from 10 a. m. to 2 p. m. on average December days, with intermediate conditions for the intervening months.

It follows then that to maintain the prescribed value of three foot-candles at the work, artificial light will be required at least in the late afternoon of Fall days, and through a large part of the mornings and afternoons of Winter days. The solid black portions of the three curves in Figure 2 indicate the parts of each day between 5 a. m. and 7 p. m when artificial light will be necessary under such circumstances. On cloudy days when the ordinates of the three curves in this diagram are much reduced below the values shown, the requirements for artificial light will be still greater. It is apparent, moreover, that artificial light will be required in a case like Figure 2, throughout the hours of the night when a night shift is employed, from 6 p. m. to 6 a. m. in June; from 5 p. m. to 7 a. m. in September; and from 2 p. m. to 10 a. m. in December.

Results of the British Investigation

The relations of lighting to management have received considerable attention in the First Report of the Departmental Committee on Lighting in Factories and Workshops (1915) in Great Britain, although unfortunately most of the results along this line are not sufficiently definite to make them applicable with any degree of satisfaction to the average problems which arise in management.

It is worthy of comment, however, that this committee mentions the fact that complaints of eye strain and headache supposedly due to poor light, are common. Further, that it is a recognized principle that poor light makes difficult the proper supervision and the detection of idleness and that inadequately lighted shops are hard to keep clean and in a sanitary condition. The same report cites one instance where the production rate fell off from 12 to 20 per cent. during the hours of artificial light, and another where the earnings of the employees were increased more than 10 per cent. following the installation of an improved system of illumination.

While conclusions of this kind are obviously merely suggestive and subject to no very tangible applications, they serve to show the ways in which industrial lighting is beginning to be looked upon, and these results may, therefore, be classed as valuable contributions to the subject and the more so, because they are based on a widespread investigation under governmental supervision.

A somewhat similar study, although on a smaller scale, was made in this country by the Federal Health Service in the observation of lighting conditions among the women's garment trades in New York City. In the instructive report which followed this study, several valuable conclusions are noted, among them being that most of the work in these trades calls for close and continuous use of the eyesight, a fact which makes the lighting problem unusually important in this particular industry. This was greatly emphasized in the study mentioned, by the conclusion that 75 per cent. of the employees, whose vision was tested, had imperfect or abnormal eyesight.

Typical Case Worked Out

To reduce the economic advantages to a somewhat more tangible basis, it is interesting to see just what relation exists between annual lighting costs and annual wages in a typical factory section for some given area. For illustration purposes, we may take a floor area of about 3,000 square feet in which 25 employees are assumed at work. With a rate of 25 cents per hour for wages, the total annual wages for this area including superintendence and overhead, may amount to $25,000. With a tungsten lighting system for certain assumed but practical energy and maintenance costs, the total annual cost for lighting this area will be about $250, from which it appears at once that the lighting amounts to about one per cent. of the wage item.

The relation just outlined is shown graphically in Figure 3. The main point to grasp is not the exact figure of one per cent., but its order of magnitude. In different industries the cost of light may vary somewhat above and below the value here given, but on the average this will be found to be a close approximation of the conditions, and from Figure 3, the contrast of wages and lighting costs is shown in an unusually helpful and convincing manner.

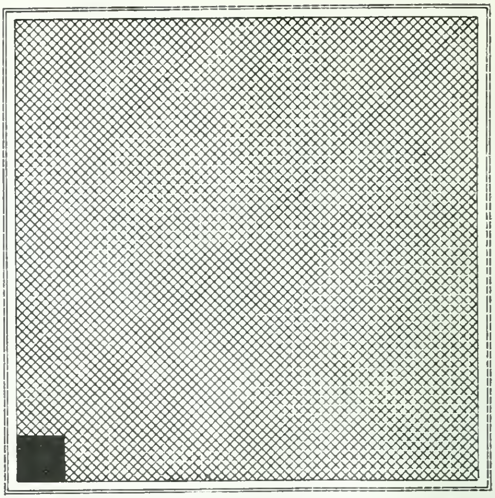


Fig. 3. WHEN THE COST OF LIGHT PER ANNUM IS EQUAL TO ONE PER CENT OF THE ANNUAL WAGES. THE LIGHTING COST BEARS THE RELATION TO THE ANNUAL WAGES SHOWN BY THIS DIAGRAM. The large square represents an annual wage charge of $25,000 for a given assumed factory area, while the solid black area represents an annual lighting charge of $250 for the same area

Accuracy and the Accident Hazard

One of the fundamental points on which the merits of a lighting system may be judged is that of the accuracy with which workmanship may be carried on. Defects in the product may often be traced to imperfect lighting, and in point of fact one of the first signs of poor light may readily be the increase of material which cannot pass the inspection department as finished product. This will naturally follow from efforts to maintain a certain production rate with inadequate lighting facilities, the workmen, in their endeavor to keep up with quantity, thus failing to maintain the requisite standard of quality.

Along with the failure to do good work under poor light, the tendency toward preventable accidents may logically be classed. Studies into the accident rates by industrial casualty insurance companies, has proved beyond any reasonable doubt, that a large number of the industrial accidents in this country are chargeable to a failure of the management to provide the proper kind of light which will act as a safeguard to employees in the handling of materials and in the ordinary routine of the day's work. This is further confirmed by the move which has been made to penalize the poorly lighted factories with higher rates for casualty insurance by these companies.

Order, Neatness and Sanitation

From the constructive point of view, the well lighted plant presents the possibilities for a more orderly arrangement of materials and work than a floor area which is dark and gloomy. Not only is it easier to enforce rules for an orderly plan of raw materials and accessories to the work, but the reaction of cheerful surroundings is such as to promote this tendency on the part of the workmen with little or no urging on the part of foremen and superintendents.

It has been found again and again that a pleasing environment has the natural effect to make employees

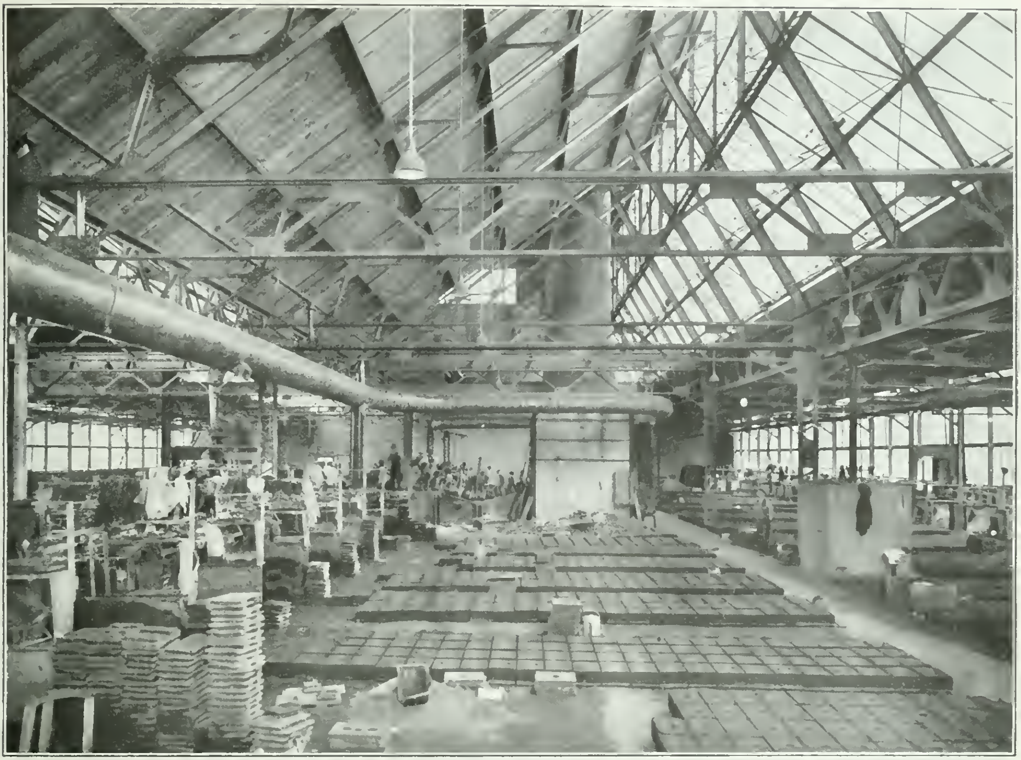


FIG. 4. DAY VIEW IN A FOUNDRY EQUIPPED WITH SPECIAL VENTILATING AND LIGHTING TRUSS.
This view gives an excellent idea of the distribution of natural light which is possible with modern window construction. Pond system.

more neat in the care of their own machines and tools, and this will be recognized at once as a factor of no small consequence in the proper maintenance of the mechanical equipment. Any factory which is noted for its cheerful surroundings and careful attention to order and neatness will quite logically be found to be sanitary and hence a more agreeable place in which to work than otherwise.

It is most interesting to note the attitude of superintendents and managements generally to good lighting facilities. The head of a gloomy shop section complains of his inability to retain a hold on the employees in their regularity and steady application to assigned tasks, and cases are on record where the very marked contrast between a gloomy section and nearby cheerful and well lighted sections, has resulted in the serious difficulty of workmen refusing to remain for more than a short time in the gloomy space. The installation of adequate lighting in such spaces has invariably resulted in a change in the attitude of the workmen and an increase in the willingness to remain permanently in the previously unpopular and avoided sections of the plant.

Lighting Legislation and Management

Within the past two or three years there has been an increasing tendency to substitute older and fragmentary state rules governing factory lighting with scientific codes covering this part of the plant equipment. From what has been said relative to the distinctive advantages of good light to the problem of management, it follows at once that the progressive plant will usually see to it that a highly satisfactory system is a part of its program for a surely successful working environment.

Hence in such cases where good lighting is installed voluntarily and is looked upon as a valuable asset, there is no need for legislation to enforce that which is considered such an important accompaniment to the successful output. Possibly the only reason which might be assigned as favorable to legislation in such cases would be that of providing minimum standards with which all industries within the jurisdiction of the given state might compare their own facilities.

Unprogressive managements, however, are to be found here and there where the attitude toward good lighting has not become one of liberality and fairness. Or again, such plants may not even appreciate, through ignorance, the advantages set forth above. For such, then, carefully prepared lighting legislation cannot well be other than a decided advantage, since the compliance with such minimum rules is likely to bring about much larger returns through the larger and improved output it makes possible, than the expenditure which must be made to comply with the legal rules in question.

Looked at in a broad minded way, therefore, the efforts of such states as Pennsylvania, New Jersey, New York, Ohio and Wisconsin in drafting out or contemplating the enactment of minimum requirements for industrial lighting are to be commended, since they can have little or no effect on the progressive plants who have voluntarily adopted a comprehensive lighting policy, and for those plants which have lagged behind in the progress of the past few years, the adherence to these rules should prove in the end nothing more nor less than a benefit for all concerned.

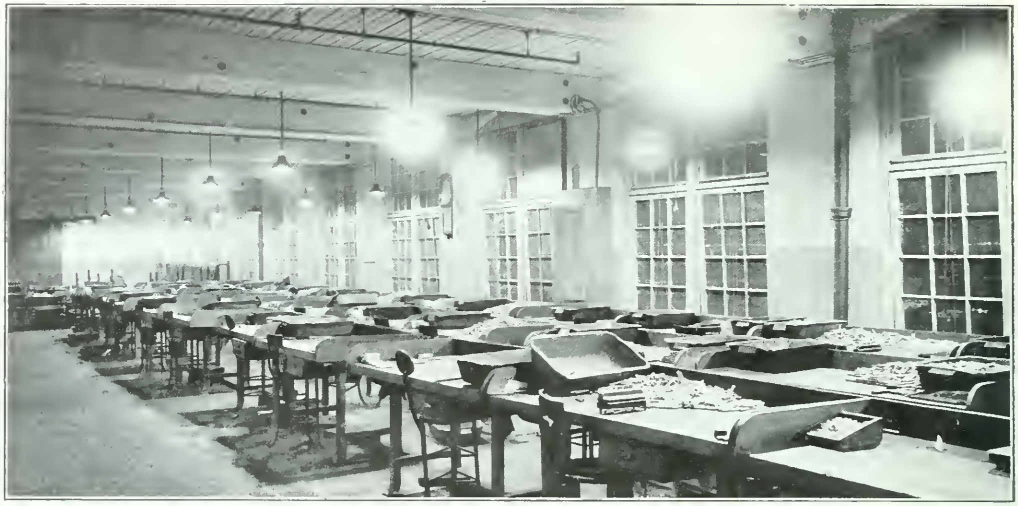


FIG. 5. NIGHT VIEW OF AN INSPECTION DEPARTMENT LIGHTED WITH MAZDA LAMPS.
Note the almost perfect uniformity of the illumination on the inspection tables and compare with Fig. 4.

Probable Future Policy Defined

The foregoing notes indicate clearly that the future policy of the industries toward lighting is likely to be one of general acceptance of the engineering methods which have evolved from the experience in plant illumination during the past six or eight years. This experience has yielded as a return thus far the knowledge of ways and means for planning and installing lighting systems which approximate closely the characteristics of natural light in the effectively daylighted building. For example, it is only necessary to point to the three interiors shown in Figures 4, 5 and 6, to prove that there is very little difference in the uniformity and general quality of artificial light in comparison with the best daylight planning. Thus the two cases of artificial light in Figures 5 and 6 compare most favorably with the results of daylight conditions as in Figure 4.

With the possibilities which have come with modern lamps and reflectors and, in turn, with recent methods of illumination design, a liberal viewpoint taken by the factory management as outlined in this article, will bring about quite naturally with time a well standardized policy toward methods and general practice, which is fully warranted by the returns and which will contribute in no small degree to the general results from the efforts in various directions to improve the environment surrounding those in industrial labor.

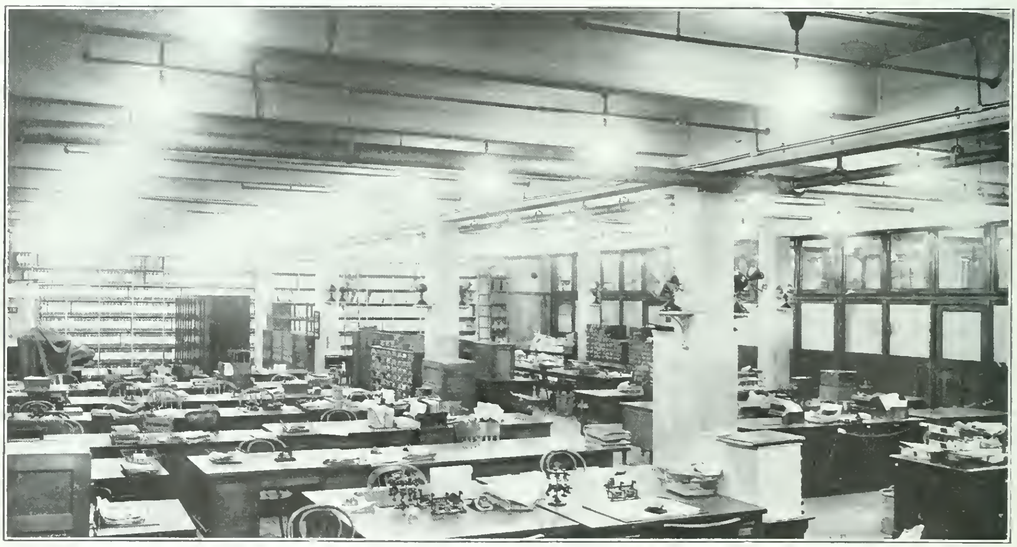


FIG. 6. INTERIOR OF AN OFFICE LIGHTED WITH MAZDA LAMPS AND HOLOPHANE REFLECTORS.
The well lighted office contributes to efficient management almost to the same degree as the well lighted manufacturing space.

Under New Management—The Fallacy of Engineering Discussion

By Charles M. Horton

At a sad cost the world war is teaching that discussions only make for delay and confusion and are therefore opposed to effectiveness. The author with a sure touch and keen insight shows that engineering discussion wastes time, destroys ideas. The great inventors have been men who thought and worked in solitude. Industry must learn this lesson.

Mr. Charles M. Horton, *member of the American Society of Mechanical Engineers, was educated in the public schools of New York City and at the University of New Mexico. He served a drafting-room apprenticeship and has had twelve years' experience in designing special machinery. During a part of that period he was in the employ of the Westinghouse Machine Company, and was personal designer to Mr. George Westinghouse in the gas-engine division. As an avocation he has pursued literary work for years, writing for both fiction and technical publications.*

HABITS are strange things. They creep in upon a man; remain subtly a part of him; grow and grow. Man is judged by his habits. Indeed habits *are* the man. His speech, his dress, his conduct generally are the sum total of the man, generally. Certainly they are that whereby his friends determine his character. Told about one or another of them, and the man himself, since frequently he is the last to realize these possessions, will lift his eyebrows in a look of genuine surprise. "You don't say! Well, now, I never thought of that! Thank you, old man—I'll do as much for you sometime. Right now, in fact, I see egg on your chin. You ought to get up earlier in the morning, old top—that seven-twenty-three waits for no man. . . Yes. . . Thank you so much—so *very* much!"

The tendency to want to discuss things, to want to enter upon a conference, never was more freely exercised than in the engineering profession. It is nothing but a habit. It is like the bent of some men to argue. I know a man who will pass up a meal anytime in order to stay with an argument. Discussion and argument, both are habits.

George Westinghouse was a genius of solitude and knew the fallacy of discussion. He was not a talker, in the sense that most engineers are talkers, although when there arose need for it, he could express himself forcibly, and usually did so. When standing with others around a drawing board, he took the initiative, and often to make his point clear, would pick up one or another of the instruments and draw—somewhat awkwardly. His sketches were rather crude. They consisted, generally, of dots and straight lines, the dots indicating crankshafts and the straight lines cylinders, connecting rods and the like. Having made these he would invariably hurry away; setting a time when he would return to see the design —never failing to return when he said—and when he came he always brought a new idea that he had thought out when alone.

As for one of them — discussion —it is bread and meat to the engineer. Why this is so, precisely, I do not know. Nevertheless I can venture an opinion. I verily believe it crept in upon the profession with the first partnership. Two men having soberly agreed to share the burdens of a business equally, including the buying of ice in summer and the purchasing of coal in winter, it was but natural they should share equally in the glory—or the shame—of their ideas. A perfectly decent resolution, viewed socially! And so, when one was struck with an idea, he promptly "got together" over it with his partner. The result of this getting together was natural, too. A corner of the idea was lopped off here; another corner built up there; the thing was sent into the shop. Thus the partnership was complete. Each had a share in the thing which made—or did not make, it all depending—for mutual profits.

So it is today—only worse. Partnerships in the industrial world frequently mean the linking together of more than two men. Every executive on the payroll is considered a partner. Therefore, partnerships often mean the equal interest of some ten or twelve men. It complicates things. Each man has his equal share of the responsibility, and each man earnestly endeavors to shoulder his equal share. Consequently, when an idea is "experienced," the man who first "feels" it—he may be the chief engineer, the general manager, the superintendent, the shop foreman—gleefully takes it to one or another of the other executives. He does this through habit, through a conviction come to him down the ages. He feels that he must share it with his partners. He does share it with his partners.

How an Idea Faces an Executive Session

What happens? I will show you. A call goes out through the plant. All the "heads"—the partners—are invited. They come—some on tiptoe, some brusquely, all curious. They go into executive session. The idea is laid before them. Its virtues are set forth; its defects pointed out; its probable values, viewed monetarily, are gravely considered. Mental confusion reigns. The man whose idea it was, feeling the germ itself slipping from him, gazes about him helplessly, scratches his head in desperation, endeavors with true pride to save a few remnants of his brain che-ild from utter destruction. Finally something goes through. The "idea" is accepted. It is decided to embody the thing in the regular methods of production. It is so embodied—after being regularly moved and seconded. Whereat the performance ends. The executives solemnly withdraw—some on tiptoe, some brusquely—all wonderingly.

Everybody's dog is nobody's dog. Everybody's idea is nobody's idea. So it became with this one. Originally the product of a single mind, after the discussion it was rampantly a part of everybody's mind. Which isn't natural—isn't natural law. No fertile seed in nature, once it possesses the flame of life, is dependent upon other like seeds for survival. A unit of life is sufficient unto itself, of its own kind, for growth, for continued life. Ideas are units of life. They are as real and tangible as the hat upon your head. This man's idea was real and full and round to him. Having flashed to him out of the ether—and to *him*, because by habit of thought and mode of living he had developed a natural affinity for original ideas; was, in a word, in tune with the infinite—it was as clear as crystal to his intelligence. Thoughts—first thoughts are always clear to original minds. They come that way—come full panoplied, as it were, out of the bosom of Minerva, or whoever or whatever it was, as set forth in Bullfinch's Mythology. Discussion diffuses them. Diffusion is a scattering. Inject a spray of anything into anything and the thing itself will thin out, fade away, disappear. So with ideas. Discussion—diffusion, scattering—robs the idea of much of its rich first values. It is being opposed to other ideas. There is bound to be a clash. Something must give way—something suffer. It is the idea which suffers.

Creative Minds Are Solitary

True creative minds work best alone. Men possessing these minds know the blessings of solitude. The "genius of solitude" is no idle phrase. Steinmetz, Edison, Marconi, Wright, all know the full flaming into their minds of new ideas. And they know how they come, and some of them whence they come. And jealously they guard them, until certain that the ideas are ripe. Then and not till then do they reveal them. There is no hurrying to others on the part of these men with the first flash of a thought. There is no discussion. The germ is permitted to gestate, to expand, to ripen in the womb where it first found life, and so is nurtured to fullness as nature would have it nurtured to fullness. Being born, having been presented as a feasible idea, the rest becomes mere mechanical detail. Certain points must, of course, be modified, to meet with existing conditions of manufacture, but the idea itself, the full-rounded germ, is theirs and theirs alone, and they shelter and protect it in silence until the proper moment of yielding arrives. Thus these men hold their own. Holding their own, the world looks to them for its pioneer movements.

The lesser lights—and that means almost every engineering office in the country—do not understand this fundamental principle in practical psychology. The moment a thought comes to them they begin to run in wild circles in quest of the opinion of others concerning it. They think that this is proper and just. It is. But also it is a fallacious attitude. By doing this they are but exposing an unripe idea before it should be exposed. The idea in consequence suffers. It is set back—diffused—scattered—annihilated, possibly. All of which need not be. The idea should be brought to fullness by one man. Having his idea, he should sit him down at a drafting-board, and mull over his idea for days and days. And he should mull in silence. The world would be the better for it. Instead of five or ten or fifteen men having control of the world's output of original thought, five hundred, ten hundred, fifteen hundred men would control the output. I realize I am giving away cherished secrets. But—like the kid who got a licking for stealing jam—I—now—sniff, sniff—I don't care. There shouldn't be a monopoly of such things. The world needs as much of that as it can get, and in as short a time as it can get it. Partners should keep away from partners when "feeling" something.

The Method of Two Consulting Engineers

There was once a firm of consulting engineers. There are a lot of firms of consulting engineers. But the particular firm I have in mind was located in New York, and it consisted of two members. One of the members was a man of simple dress, simple deportment, simplicity of idea. Indeed, his ideas were so profoundly simple, so utterly free from the complex, he himself seemed always to question their practical value. In this he was consistent, too. There are none so easily dissuaded from an idea as those who have frequent ideas. This man often revealed his timidity. In fact, having an idea and being afraid if it were synonymous with him. His partner was not this way, naturally. That was why they were partners. He was a huge hulk of a man, given to the ornate in dress and speech, and more than ornate in his ideas. Also, he was a very positive character. Presented with an idea from his more simple-disposed associate, this ornate individual would shoot back his cuffs, clear out his throat with a great noise, and otherwise prepare for action.

"Er—let me see, Fielding," he would begin, the while stroking his chin thoughtfully. "I don't just like it. A pencil, please! Thank you! Now, let's see. A sheet of paper? Let me have that pad, please! I thank you. *Now*—let's see. I think if I—er—were to shape this so"—hasty sketch—"and bring a curve in here"—another swift line—"the idea would—What? Oh, I rather fancy not! That is acceptable practice. What? Well, perhaps! Suppose we try this, then." Further sketching. "I'm somewhat taken with this. What do you think about it? You do not think you like it? And why, pray? That is standard construction. I have seen —Wait a minute! We might do this." Some more sketching—hastily. "There! I'm sure we have it, now! I recall—Your rubber, please. Thank you! I've just thought of a better idea. I think if we were to shape this something after this fashion—so—and turn that up a little—and cast a lug on this rib after this manner"—more hurried pencil work—"we shall be able to hold fairly close to your original idea. You do not think you like it? Well, then, suppose we do this"—and so on, and so on.

Working of the Engineer Mind

The above is a graphic description of the workings of the average engineering mind as practiced in the majority of drawing-rooms in this country. The method is not effective, not efficient. Ideas—real ideas—do not present themselves that way. The initial thought, as submitted by the man of single ideas, was feasible and eminently practicable. It usually was. But it rarely remained that. The complex-minded member saw that, grimly. He seemed to take delight in this. He would slash into the thing, effecting change after change because he had to, once started, since one change would effect the design in such a way as to make necessary a change elsewhere, which in turn would necessitate yet another change in some other particular, until the thing, when finished—while possibly workable still—would be a maze of unit-intricacies destined to set up havoc, if not in the machine shop, then assuredly in the pattern shop and foundry. Originally practically perfect, owing to the fact that it was the output of a single brain, later it was anything you might care to call it. The idea had been submitted to discussion; had been dragged through a conference; had been "got together" over. All too soon. It should have been permitted to ferment, to gestate, to grow, to blossom, to expand into its rightful own.

I have spent a many years in drafting-rooms. As a detailer first, and later as a designer, I have found myself and my drawing board and my drawings the center of more wars waged around an idea than I have days over my head. I have stood back and listened. Standing back and listening, and for so many years, I have had opportunities more than the average among men to observe the workings of individual brains in collective debate. It was never other than interesting to me. It was interesting as a study of mankind, if nothing else. And standing thus, and listening, and noting with all due solemnity the giving and taking of ideas, I have thought on many things.

One of these things was a definite, firm-fixed conclusion that ideas dragged through these jagged discourses suffered—suffered for lack of concentration on the part of one man. Ideas set forth—launched—under these circumstances cannot but be only half-baked—half-realized before being uttered—gauntlets flung down, for the most part, in constrained heat. Most men give of ideas willingly but take of ideas unwillingly. Behind the giving and the taking of ideas in a conference lies a certain mild feeling of enmity—spirit of belligerence—of antagonism. The idea itself, of course, suffers.

George Westinghouse—A Man of Solitude

George Westinghouse's was a mind singularly free from the complex. He was one of the few men of to-day who knew the genius of solitude. He was a man alone. Of all his interests—and he had many—the Westinghouse Machine Company was his particular pride and joy. It was this, because the organization and diversified character of its output permitted him greatest opportunities for carrying on experiments. He came and went in that plant alone—always alone. And always when he came he brought a new idea with him. Take the idea of the double-flow turbine. That idea sprang full panoplied, unquestionably, into his mind. *When* it sprang thither, no man rightly can say—now. But this I myself will vouchsafe: he did not take it to his subordinates—not at first. Instead, he asked for, and was directed to, the best thermo-dynamic mathematician on the company's payroll. Having bowed amiably, he got together with this man. He did not get together with him as do the majority of engineers in the profession. The slide-rule expert seated on one side of a flat table, the inventor seated on the opposite side of the same table, the table itself well apart from the rest of the drawing-room, he got together with his man as master and servant. There was no vigorous questioning of ideas; no exchange of opposed thought; no discussion; no conference. Westinghouse put his mathematical queries, and the man with the slide rule worked them out in silence. Thus the man with the idea came to know the exact value of his idea. And evidently he found it good. It was not long thereafter when orders were issued to work up the design—the first of its kind—and to put the drawings into the shop as rapidly as possible.

Westinghouse knew the fallacy of discussion. Whether he thought so or not, I do not know. Nevertheless, he knew it. His immediate subordinates were men pursuing the accepted methods in practice in all drawing rooms, and in consequence Westinghouse frequently found himself being led to a design on a board. But always he moved reluctantly, always with a look of foreboding in his eyes, always as one suffering a form of mental distress. He did not like it; knew the error of it; was too much of a gentleman, obviously, to offer resistance. As a matter of fact, design as such rarely interested him. That was detail. The big idea alone held his attention; and it *held* his attention, was held to him, a part of him, and him alone, until safely past the danger zone. Yet he was unable to deny his immediate subordinates, and so permitted himself to be led to the drafting boards. Once at the boards, it was noticeable that he invariably gave intelligent heed to what the draftsman had to say as well as to what the engineers had to say. He seemed to realize that a man bent over a project day in and day out for weeks at a time, as was the case with many of the designs, would know more about the thing than would the supervising engineers who came only at irregular intervals. And always—as I saw many times—having come on the wings of his engineers, he would hurry away as soon as grace would permit. He was a man alone—knew the power that lies in individual thinking—seemed always to want to get by himself.

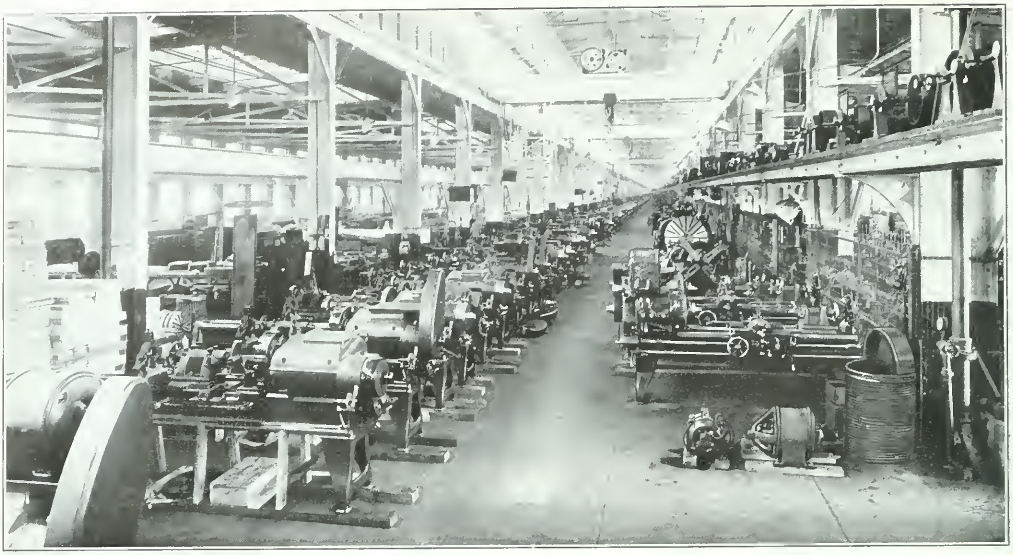
Discussion Is Confusion

Discussion at best is noise. It drums against the ear-bones; is transmitted to the brain; sets up mild Bedlam. The wires get crossed; form brief intermittent contacts; scurry helter-skelter. Ideas come and go and come again. Thoughts bump into thoughts, are whirled back, are sent forward again. Direct, hard, cold thinking, reasoning, is wellnigh impossible under these conditions. The chief speaks; then the general manager; then the foreman of the drafting-room; occasionally the draftsman utters mild sounds. All is chaos; all is sound; all is interruption. Thus it goes on, till a telephone calls one or another away, or till one or another, having tossed out what he believes to be the last word on the thing, himself hurries off before someone else can toss down an idea that will explode his own idea. It is a beautiful condition of affairs. It exists, though, as everybody actively engaged in the work of the profession will admit. That it is wrong—error—a habit of mind that should be discouraged—will strike many as carping criticism, however. But is it?

Power of the Single Unit

The World War has proven a great awakener. It has been the source of a great awakening in a number of vital directions. One of these directions—and surely not the least important—points flamingly toward the power that lies in a single unit of being. A single being is a single mind. A single mind is the recipient of single ideas. These ideas may be either good or bad, but always they are his alone who initially thought them, and because they may be good or bad they are a great power for good or bad. I hold no brief for autocracy. But I do maintain that a single mind bent upon destruction or construction is more effective than two minds bent toward the same end—or four minds, or ten minds, or a hundred minds. The thing is centralized, localized, and being such will bear upon a given situation with all the blazing accuracy and penetration of a bolt of lightning from on high. Two minds bent in the same direction diffuse the idea. Three minds diffuse the idea more. It is a direct increasing ratio. England has discovered this truth, as America is now discovering it, with the result that war boards have been, and are being, cut down steadily to the bone. One man—the womb of single ideas—was found to be more effective in the work of major directing than a dozen men. It had to be—it had to come to that. It was learned, and at sad cost, that discussions only made for delay and confusion and therefore the opposite of effectiveness. The industrial world ought to profit by the lesson.

"The successful outcome of the war is so dependent upon the applications of science that the United States can ill afford at this time to risk any diminution of this supply of technically trained men. Such diminution we must in part suffer by reason of the fact that class exemptions in the execution of the selective service law are prejudicial to its general success; but I have constantly in mind the fact that the Government service will demand more and more scientifically trained men." —Hon. Newton D. Baker, Secretary of War, in U. S. Official Bulletin.



Lodge and Shipley Control System

Shop Inspection and Assembly

By D. M. Perrill

Customers to be satisfied must receive machines that are properly assembled from interchangeable parts, and if a piece is ordered for repair and replacement it must enter its place without fitting or alteration. To accomplish these technical results and gain the good will of this satisfaction all manufactured parts must be controlled by adequate shop inspection. Just how this inspection is done on engine lathes and the machines assembled in a representative machine-tool building plant are described in this article.

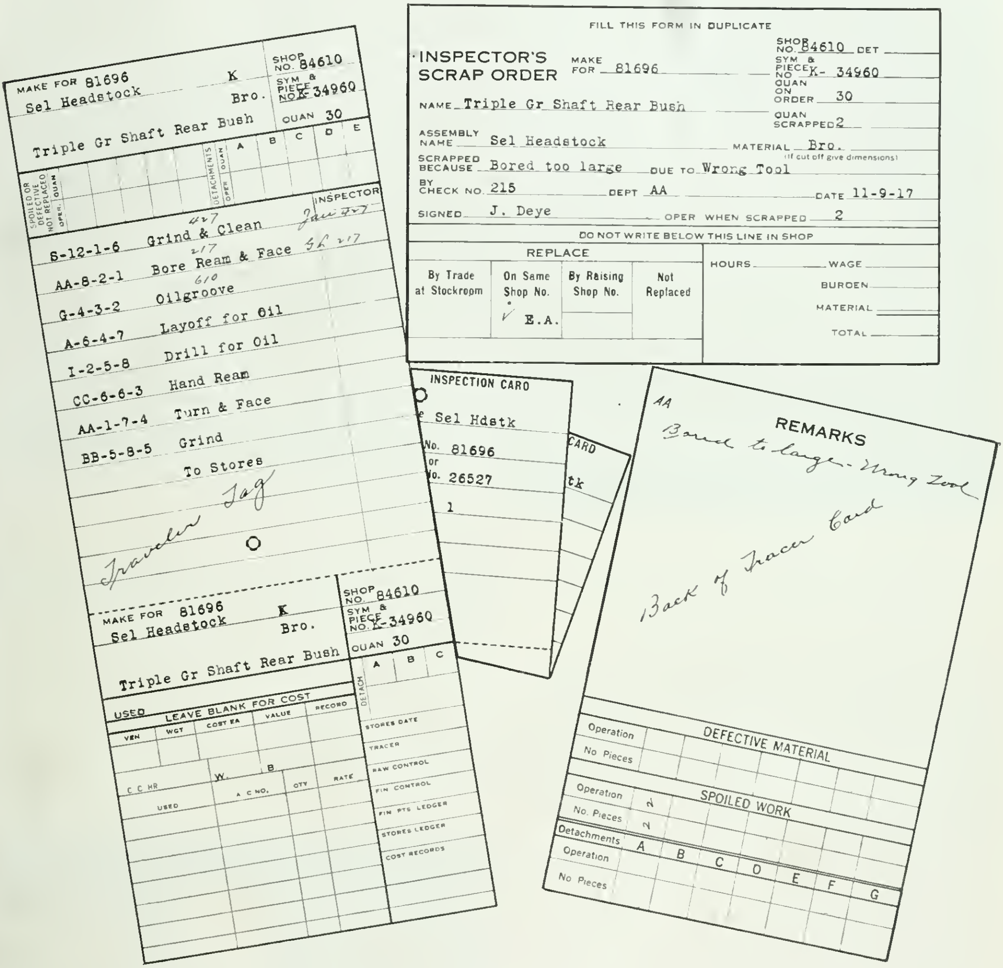
Mr. D. M. Perrill *has specialized on the engineering advertising of manufactured products. He was in the engineering division of Armour & Company in 1912, in the mechanical engineering division of the Kansas State Agricultural College in 1913, in the shop of the United Refrigerator & Ice Machine Company in 1913, manager of ice machine sales in the southwest in 1914, with the Linde Canadian Refrigeration Company in 1915, and at present is advertising manager for the Lodge & Shipley Machine Tool Company.*

In grouping the two subjects of shop inspection and assembly into one article I have hoped to emphasize the importance of inspection of parts in connection with the work of assembly. In manufacturing any product that must be finished in an accurate manner, slipshod work in the production of the parts is always paid for in extra filing and scraping in assembling. The Lodge and Shipley Machine Tool Company has been able by increasing and strengthening its inspection, to assemble almost double the output with slightly more than half the force formerly used on the erecting and assembling floors. This has been done by manufacturing the various parts so that they go together without special fitting. Such manufacture can only be secured by thorough and complete inspection, not only of every piece, but of every piece at each operation in its manufacture.

This inspection has been carried throughout the entire range of manufacture so that these results are not confined to any certain sizes. As a concrete example take the ball bearing, eighteen-speed headstock of the 48-inch lathe. This size of lathe is manufactured in smaller quantities than any other that the company makes and may therefore be taken as the most extreme example. Yet by rigid and accurate inspection the parts fit so accurately that with two fingers on the belt wheel one can run the complete train of gears and faceplate moving over two tons of machinery. You can dismount ten of these heads and throw the parts into a pile, take out the parts for a head, assemble it, and obtain the same results.

The Repair Parts Problem

The advantage of inspection which will secure such interchangeability is not confined to manufacture alone, although the results there quite warrant its use. Whether we like to consider it or not, if we are manufacturing and selling a machine, sooner or later we will be called upon for repair parts. If the sale of the machine is to be continued, the furnishing of these repair parts is of the greatest importance, particularly where the original purchaser of the machine is still using it. No matter who is at fault, the man who has a machine shut down for repairs is in a distinctly dissatisfied frame of mind; if he is not already dissatisfied with the machine, the slightest error or delay in securing repairs will antagonize him toward the machine, or the maker, or both. There is only one thing that will satisfy that man and make him an ardent booster. That is furnishing the proper repair part promptly, one that can be put in place quickly and that will work without special fitting or alteration.



MAKE FOR 81696 K
Sel Headstock Bro.
Triple Gr Shaft Rear Bush
SHOP NO. 84610
SYM & PIECE NO. K-34960
QUAN 30

SPOILED OR DEFECTIVE NOT REPLACED OPER. QUAN DETACHMENTS OPER QUAN A B C D E

INSPECTOR

S-12-1-6 Grind & Clean 427 Jan 427
AA-8-2-1 Bore Ream & Face 217 SL 217
G-4-3-2 Oilgroove 610
A-6-4-7 Layoff for Oil
I-2-5-8 Drill for Oil
CC-6-6-3 Hand Ream
AA-1-7-4 Turn & Face
BB-5-8-5 Grind
To Stores

Traveler Tag

MAKE FOR 81696 K
Sel Headstock Bro.
Triple Gr Shaft Rear Bush
SHOP NO. 84610
SYM & PIECE NO. K-34960
QUAN 30
DETACH A B C

USED LEAVE BLANK FOR COST
VEN WGT COST EA VALUE RECORD
W. B
C C HR USED A C NO. QTY RATE

STORES DATE
TRACER
RAW CONTROL
FIN CONTROL
FIN PTS LEDGER
STORES LEDGER
COST RECORDS

FILL THIS FORM IN DUPLICATE

INSPECTOR'S SCRAP ORDER

MAKE FOR 81696
SHOP NO. 84610 DET
SYM & PIECE NO K- 34960
QUAN ON ORDER 30
NAME Triple Gr Shaft Rear Bush
QUAN SCRAPPED 2
ASSEMBLY NAME Sel Headstock
MATERIAL Bro.
(If cut off give dimensions)
SCRAPPED BECAUSE Bored too large DUE TO Wrong Tool
BY CHECK NO. 215 DEPT AA DATE 11-9-17
SIGNED J. Deye OPER WHEN SCRAPPED 2

DO NOT WRITE BELOW THIS LINE IN SHOP

REPLACE				
By Trade at Stockroom	On Same Shop No.	By Raising Shop No.	Not Replaced	
	✓ E.A.			

HOURS WAGE
BURDEN
MATERIAL
TOTAL

INSPECTION CARD
Sel Hdstk
No. 81696
or
No. 26527
1

CARD
tk

AA
REMARKS
Bored to large - Wrong Tool
Back of Tracer Card

	DEFECTIVE MATERIAL						
Operation							
No Pieces							
	SPOILED WORK						
Operation	2						
No. Pieces	2						
Detachments	A	B	C	D	E	F	G
Operation							
No Pieces							

FIG. I. INSPECTION CARDS, SHOWING TRAVELER TAG, SCRAP ORDER AND SPOILED WORK RECORDS

In an entirely different organization building another line of machinery, I once had the job of building up a territory that had "gone bad." The trouble was entirely due to three plants representing three typical trouble cases; in one the customer had misused his machine, in another the customer had insisted on purchasing a piece of equipment not adapted for his work, and in the third to close an order the salesman had assured the customer his foundation was good enough when it was not. From a standpoint of justice the only place the manufacturer or his representative was at fault was in the last instance, but the cases had been so advertised by our loving friends that it took a lot of money and a half year's hard work to get any returns from the territory, and then only after the three customers had been satisfied. Doubtless even then we never regained the prestige we might have had.

Inspection and Machine Maintenance

I have digressed in the above paragraphs to emphasize the necessity of service in maintaining the machine after it has been sold. I have done this because proper service, embodying as it does repairs, can only be furnished in a line such as engine lathes, by properly manufacturing the original product itself so that its parts are interchangeable. To secure this result nothing is so important as inspection, not just inspection of the final machine or the units of which it is made, not even the inspection of the individual piece, but the inspection throughout the manufacture of every piece at every operation. If the original machine could not be put together without special fitting, there is certainly no chance of the repair part fitting nicely and easily.

Equally important is the matter of poor assembly, which almost always results from special fitting of parts. Poor alignment that wears out parts or gives an inaccurate machine, parts under unnatural stresses that eventually strain and rack the machine, friction which develops from tight fits and wastes power and makes the machine hard to handle—all of these and more are the regular toll of poor inspection in production.

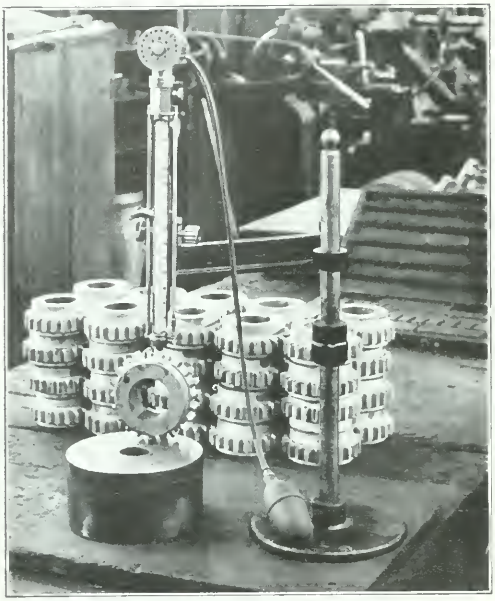


FIG. 2. INSPECTOR'S BENCH (PARTIAL VIEW). THESE BENCHES ARE LOCATED IN VARIOUS DEPARTMENTS, AND ARE USED FOR INSPECTING WORK THAT MAY BE EASILY TRUCKED TO THEM

Duties of the Inspector

It is the duty of the inspector to see that the parts are made according to design. In order that these parts fit correctly, it is necessary that this design should be right. Too much emphasis can scarcely be laid on this point, for unless the inspector and the men who perform the actual operations in manufacture have confidence in the working drawing, they cannot be expected to place very great importance on the limits or dimensions given. Mistakes in design are usually not discovered until the parts are actually being erected, and will then cause all of the inconvenience and expense which will come from any form of shortage. These have been mentioned before but are so important that I will sum them up again; obtaining material for immediate delivery, rushing the work through the shop, special supervision, incomplete machines tying up the erection floor, capital tied up in incomplete stock, breaking up of the shop routine and existing schedules of work. But these are not the worst effects which come from mistakes in design that are not discovered until the pieces have been manufactured.

To have made a piece correctly, maybe carefully and painstakingly and even proudly, and then to have it consigned to the scrap heap; what if the man is paid for his time, what if he is not responsible for the output, if he has anything in his work beyond his wages, if he is one of the men who do not only listen for the whistle, if he is the kind of a man whom you want he is going to be hurt when that piece is scrapped, and hurt badly. I believe it is the worst form of curse which you can visit on the head of the long suffering workman. To him it is usually inexcusable, he rarely has any training in drafting and therefore does not appreciate the thousand and one pitfalls which arise to ensnare the feet of the unsuspecting designer, he only knows that he did the job right and it didn't do a bit of good. He feels that he might just as well turn them out any old way. Nothing else will so surely destroy confidence in instructions, nothing will so surely remove any feeling of responsibility, nothing will break up the feeling of coöperation between the management and the men, as incorrect and faulty designs. Designs that can be depended on are the first requisite to inspection that produces results.

Inspection should not be regarded so much a matter of finding, as a matter of preventing spoiled and defective work. Both divisions may be further subdivided into work which may be repaired, and that which has to be scrapped. Defective work, usually due to poor castings, can generally be discounted in advance by ordering a slightly larger quantity than is required. Spoiled work, however, is one of the most aggravating causes of shortages. The importance attached to the prevention of losses from spoiled work is shown in the following set of instructions which are sent out to the foremen.

Spoiled Work

Stop a minute and consider *spoiled work*. IF EVERY man in this shop will appreciate *FULLY* what it means, the amount of it will be cut 90 per cent.

There is FIRST, the direct loss which includes the cost of the material and the labor which has been spent upon it. There may be a small scrap value, but otherwise what is lost can NEVER BE RECOVERED. This single loss alone amounts at the present time to the equivalent of TWO TWENTY-INCH LATHES a month.

But the direct loss is only a beginning. There are other GREATER losses. The *spoiled pieces* must be replaced usually in a small quantity lot. It costs from THREE TO TEN TIMES as much per piece to make TEN pieces in a lot as it does to make a HUNDRED. Sometimes the ratio is even greater. Also, rush jobs are always MORE EXPENSIVE than regular jobs and replacements of *spoiled work* is always a rush job.

While this small quantity job is being done, there might be done instead of it some other job which is thus CROWDED OUT of its place in the schedule by the *spoiled work*. The upsetting of the manufacturing schedule is the hardest thing to put an exact value upon but is the GREATEST LOSS that we have due to *spoiled work*.

Remember, that raw material not only COSTS MORE at the present time than ever before, but is much harder to get. Every time the foundry runs on a short lot of a few pieces to

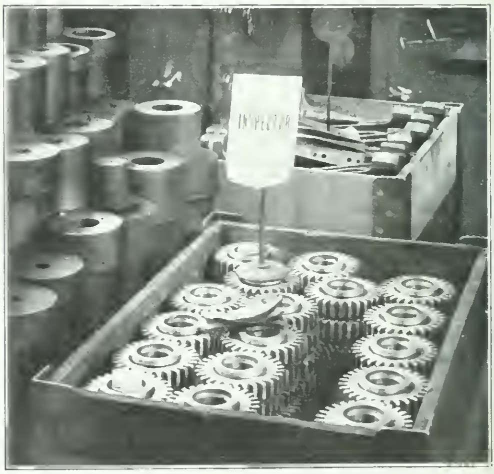


FIG. 3. TWO BOXES OF PARTS, ONE WITH AN ENVELOPE MARKED "INSPECTOR" PULLED OVER THE METAL FLAG INDICATING IT IS TO BE INSPECTED, THE OTHER WITH METAL FLAG BARE, INDICATING IT IS READY FOR THE NEXT OPERATION

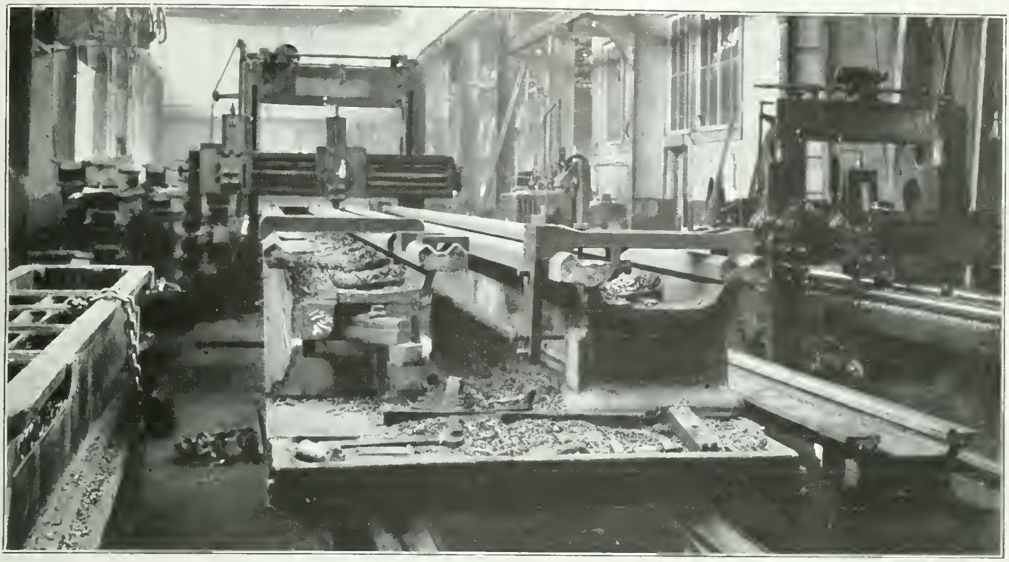


FIG. 4. JIGS USED IN CHECKING UP THE OPERATIONS IN PLANING LATHE BED
INSPECTION OF HEAVY WORK IS MADE AT THE MACHINE

replace *spoiled work*, it is taking time that would produce much needed material for regular work. It is also taking the TIME of the PURCHASING DEPARTMENT in getting the order for this replacement material pushed ahead of the older orders already placed. Some times it is ALMOST IMPOSSIBLE to get the replacement material at all, and by the time it is obtained, the work for which it is needed has been DELAYED beyond the possibility of any approach to efficient production. In certain cases such delay has caused a LOSS through PENALTIES which has more than wiped out any profit on the order. Also, where there are no penalties involved, the shortage on the Erection Floor will PUT OFF the SHIPMENT of some given machines at a time when there is nothing else that can be substituted for them on the shipment schedule. This is a loss that can NEVER be made up. *Spoiled work* does it.

Work that is imperfectly done so that it must be done over or patched up, may save the direct loss of the material, but the delay due to time spent on it is just as SERIOUS and EXPENSIVE as in the case of *spoiled work*.

Careful observation of three small rules will help greatly:

First. Make SURE that the first piece in every set-up is PASSED by the inspector before doing any further work on the job. This is a simple rule and MUST be obeyed.

Second. If a BLUE PRINT is SMUDGED so that you cannot be sure of the figures, or if you are in doubt of the meaning, put it up to the foreman—DON'T GUESS. Better lose time making sure than *spoil work*.. DON'T use an INDISTINCT blue print, insist on a fresh one.

Third. DON'T use a jig or tool that you think is in bad shape. Put it up to the foreman. Be sure that he explains its use to you fully.

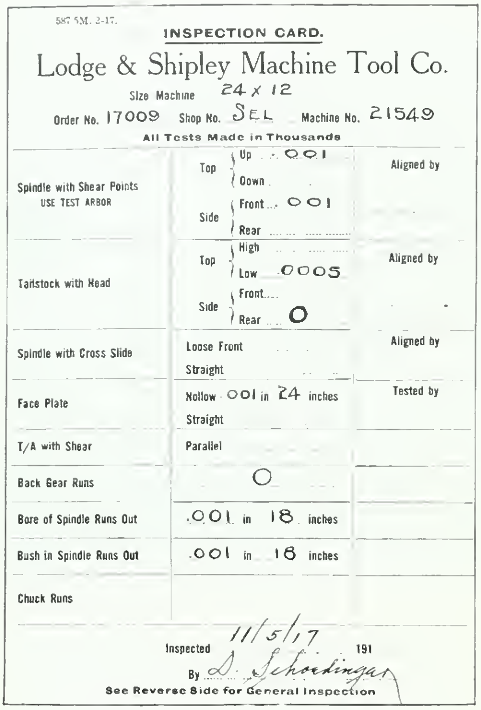
Cutting down *SPOILED WORK* will save money, increase the production, cheapen the cost and RAISE WAGES.

First-Piece Inspection

The inspection of the first piece is not only to see that it is being made to the proper dimensions, but also to see that it is being made in the best way. This prevents poor set-ups, wrong tools, incorrect feeds and speeds, etc. This method almost eliminates spoilage of the entire run. It does not, however, prevent the spoilage of occasional pieces. In order that the effect of this spoilage be reduced as far as possible it is absolutely essential that the spoilage be found at the operation where it occurred. To assure this, inspection of every piece is made at each operation. With each lot of pieces is a traveler tag as shown in Figure 1. This tag shows the operations and the routing required to manufacture the piece. On one side of this traveler tag is a column for the inspector to insert his punch mark. A separate punch is used by each inspector. To prevent the job going through additional operations before being inspected, the inspector's punch mark must be entered against the preceding operation before the timekeeper can give it out for the next operation. On giving out the work the timekeeper is required to enter his initials opposite the operation. If the preceding operation was not inspected he can be held responsible.

Inspection of the finished work is done both on special inspection benches and at the machine. Figure 2 shows one of these inspection benches for inspecting gears and milled work. These benches are located in the various departments whose work is of such size as to make the item of trucking small. Figure 3 shows a group of finished parts ready to be taken to the inspection bench. Note the upright flag with the envelope marked "INSPECTOR" over it. When the parts have been inspected the inspector removes the envelope leaving the flag bare indicating that the parts are inspected and ready to be moved to the next operation. One of the flags with the envelope removed will be seen in the background of Figure 3 standing on some parts that have been inspected. Figure 4 shows the jigs used in checking up the planing operations on a bed at the planer. This illustrates the method used on work that is too heavy to be removed to the special inspector's bench.

When the inspector locates spoiled work he makes out an inspector's scrap order also shown in Figure 1. This sheet not only states the quantity spoiled but it also gives information as to how they were spoiled, so that steps can be taken to prevent recurrences. The same methods are used in connection with defective work. Not only does this assist in entering orders large enough to cover possible spoilage, but it is also possible often to eliminate the trouble of redesigning the piece. In cases of castings sometimes the pouring of the cast-



587 5M. 2-17.

INSPECTION CARD.

Lodge & Shipley Machine Tool Co.

Size Machine 24 x 12

Order No. 17009 Shop No. SEL Machine No. 21549

All Tests Made in Thousands

Spindle with Shear Points USE TEST ARBOR	Top Up	.001	Aligned by
	Top Down		
	Side Front	001	
	Side Rear		
Tailstock with Head	Top High		Aligned by
	Top Low	.0005	
	Side Front		
	Side Rear	0	
Spindle with Cross Slide	Loose Front		Aligned by
	Straight		
Face Plate	Nollow 001 in 24 inches		Tested by
	Straight		
T/A with Shear	Parallel		
Back Gear Runs	0		
Bore of Spindle Runs Out	.001 in 18 inches		
Bush in Spindle Runs Out	.001 in 18 inches		
Chuck Runs			

Inspected 11/5/17 191

By D. Schoedinger

See Reverse Side for General Inspection

FIG. 5. FINAL INSPECTION CARD USED FOR FINISHED LATHE

ing in a different way will prevent further trouble. It is sometimes advisable too to change the material used. It is most essential that this record be kept if inspection is to not only find every piece that is spoiled or defective but to also find the cause and either remove it or prevent its reappearing. This inspector's scrap order is sent in to the tracing desk which makes a note on the back of the tracer card. The back to this card is shown in Figure 1 and provides for recording all of the information shown on the inspector's scrap order, not already shown on the front of the tracer card. The inspector's scrap order also serves as a requisition to order out a new lot of parts in case the spoilage has created a shortage.

A similar traveler tag to that shown in Figure 1, which is used for the pieces, is also used for the units or assemblies. The inspector punches this tag opposite each operation. Besides these inspections the assembly gets a final inspection after it has been completed. When the man finishes the erection of a unit he attaches an inspection tag in duplicate, see Figure 1. The tag is punched by the inspector. The same inspector's scrap order is used as for the parts.

Assembling in Lots

The final assembly of the lathe is made in the lots from which the shop orders were originally laid out. About two weeks before the time for the lot of lathes to go on the erection floor, run cards are gotten out showing all of the orders covering the lot. One of these cards is shown in Figure 6. On it are shown the quantity of lathes and the length of bed called for by the order, besides all of the specials required are indicated by means of abbreviations, as M/G (metric gears) etc. These run cards are sent out to all foremen as a notice to get all specials ready, or to take care of any shortages which may exist for this run. A run card is also sent to the engineering department as a requisition to issue the floor erection sheets, shown in Figure 7. These sheets are issued under the given run number and shows the assemblies and quantity of each assembly required to erect the entire lot of lathes. Besides the assemblies the sheets also cover all parts required in erection which are not a part of any assembly, as well as parts to be furnished by outside manufacturers such as motors. Four copies are made up of the floor erection sheets which are used as follows:

One set goes to the stock control for writing up necessary requisitions and as a final check of the control work to make certain everything is ordered.

One set goes to the cost department for use in computing costs.

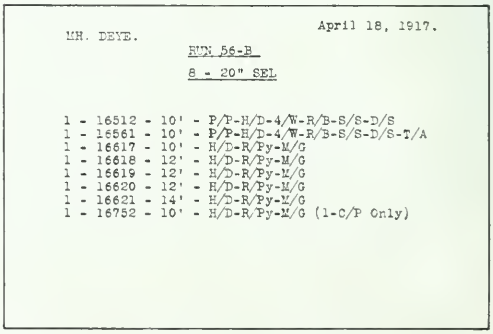
One set goes to the erecting foreman.

One set goes to the final inspector against which he checks off the outgoing lathes to see if all of the material called for on the floor erection sheet is used up in the run.

The requisitions are now sent out to the erecting foreman who sends them to the store room bringing out the required assemblies and material. From this material the erecting foreman proceeds to erect the machines called for by the machine erection tag.

The machine erection tag, shown in Figure 8, originates in the engineering department. One tag is issued for every machine. This tag carries the number of the machine. These numbers are given out by the sales department solely for the purpose of identification, and run consecutively without regard to the size or style of machine or the order of manufacture. The machine erection tag carries everything on the order, specials being typewritten below. Five duplicate copies are made of the tag in book form. These all go to the tracer who makes out a duplicate on a blackboard in order to better visualize the information and send them out to the erection foreman.

The erection foreman now assembles the machine in the lot according to the machine erection tags. After he has finished, he sends them to the inspection floor where they receive both a stationary and a running test. While making the inspection, the inspector fills out the inspection card shown in Figure 5. Any special information is written on the back of the card. This card is filed as a permanent record. The machine, with the machine tag still attached, now goes to the final inspector who checks up all of the assemblies. As he does this he inserts the design number of each assembly under each assembly heading. When the machine is shipped one of the machine erection tags remains on it. The others



April 18, 1917.

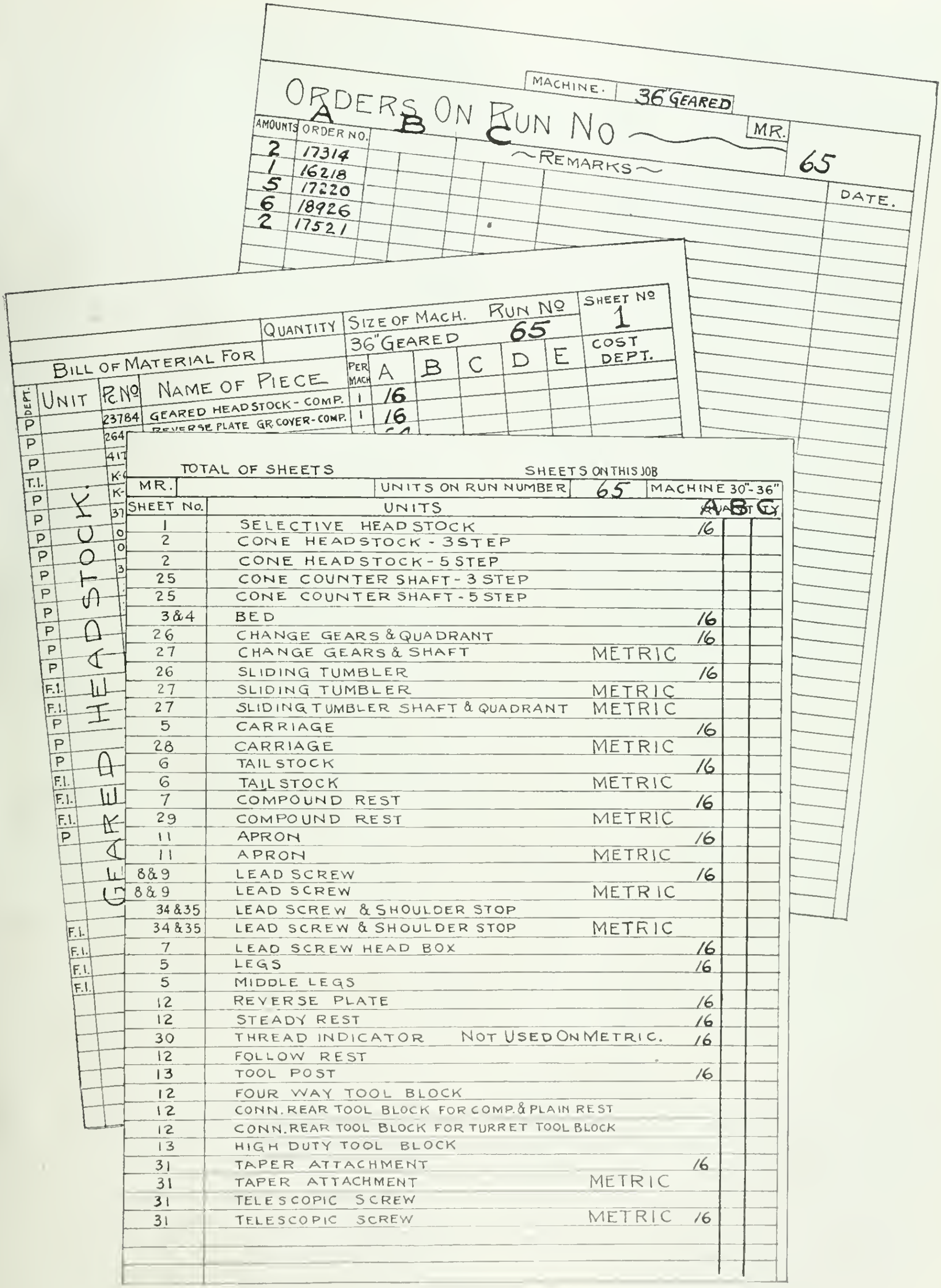
MR. DEYE.

RUN 56-B

8 - 20" SEL

1 - 16512 - 10' - P/P-H/D-4/W-R/B-S/S-D/S
1 - 16561 - 10' - P/P-H/D-4/W-R/B-S/S-D/S-T/A
1 - 16617 - 10' - H/D-R/Py-M/G
1 - 16618 - 12' - H/D-R/Py-M/G
1 - 16619 - 12' - H/D-R/Py-M/G
1 - 16620 - 12' - H/D-R/Py-M/G
1 - 16621 - 14' - H/D-R/Py-M/G
1 - 16752 - 10' - H/D-R/Py-M/G (1-C/P Only)

FIG. 6. RUN CARDS FOR LOT ORDERS



ORDERS ON RUN NO 65

MACHINE. 36" GEARED

MR.

AMOUNTS	ORDER NO.	A	B	C	~REMARKS~	DATE.
2	17314					
1	16218					
5	17220					
6	18926					
2	17521					

BILL OF MATERIAL FOR

QUANTITY

SIZE OF MACH. 36" GEARED

RUN NO 65

SHEET NO 1

COST DEPT.

DEPT.	UNIT	PC. NO	NAME OF PIECE	PER MACH	A	B	C	D	E
P	GEARED HEADSTOCK.	23784	GEARED HEAD STOCK - COMP.	1	16				
P		264	REVERSE PLATE GR. COVER - COMP.	1	16				
P		417							
T.I.		K-							
P		K-							
P		37							
P		0							
P		0							
P		3							
P									
P									
P									
P									
P									
F.I.									
F.I.									
P									
P									
P									
F.I.									
F.I.									
F.I.									
P									
F.I.									
F.I.									
F.I.									
F.I.									

TOTAL OF SHEETS

SHEETS ON THIS JOB

MR.

UNITS ON RUN NUMBER 65

MACHINE 30"-36"

SHEET No.	UNITS		A	B	C
1	SELECTIVE HEAD STOCK		16		
2	CONE HEADSTOCK - 3 STEP				
2	CONE HEADSTOCK - 5 STEP				
25	CONE COUNTER SHAFT - 3 STEP				
25	CONE COUNTER SHAFT - 5 STEP				
3&4	BED		16		
26	CHANGE GEARS & QUADRANT		16		
27	CHANGE GEARS & SHAFT	METRIC			
26	SLIDING TUMBLER		16		
27	SLIDING TUMBLER	METRIC			
27	SLIDING TUMBLER SHAFT & QUADRANT	METRIC			
5	CARRIAGE		16		
28	CARRIAGE	METRIC			
6	TAIL STOCK		16		
6	TAIL STOCK	METRIC			
7	COMPOUND REST		16		
29	COMPOUND REST	METRIC			
11	APRON		16		
11	APRON	METRIC			
8&9	LEAD SCREW		16		
8&9	LEAD SCREW	METRIC			
34&35	LEAD SCREW & SHOULDER STOP				
34&35	LEAD SCREW & SHOULDER STOP	METRIC			
7	LEAD SCREW HEAD BOX		16		
5	LEGS		16		
5	MIDDLE LEGS				
12	REVERSE PLATE		16		
12	STEADY REST		16		
30	THREAD INDICATOR	NOT USED ON METRIC.	16		
12	FOLLOW REST				
13	TOOL POST		16		
12	FOUR WAY TOOL BLOCK				
12	CONN. REAR TOOL BLOCK FOR COMP. & PLAIN REST				
12	CONN. REAR TOOL BLOCK FOR TURRET TOOL BLOCK				
13	HIGH DUTY TOOL BLOCK				
31	TAPER ATTACHMENT		16		
31	TAPER ATTACHMENT	METRIC			
31	TELESCOPIC SCREW				
31	TELESCOPIC SCREW	METRIC	16		

FIG. 7. FLOOR ERECTION SHEETS. THREE TYPES OF SHEETS ARE USED, ONE SHOWS THE UNITS REQUIRED TO ASSEMBLE THE ENTIRE RUN. ANOTHER SHOWS THE MATERIAL SUCH AS BOLTS, CAP SCREWS, ETC., NECESSARY TO ASSEMBLE EACH UNIT TO THE LATHE, THE THIRD SHEET SHOWS THE COMMERCIAL ORDERS WHICH ARE FILLED BY THE RUN OF LATHES

are removed by the final inspector who sends one each to the following:

Cost department, cashier, shipping clerk, engineering department.

The card sent to the engineering department becomes the permanent record of the machine. It will be noted that the final inspector has inserted on this the design number of every assembly so that it is possible to find out the exact style of any part on the machine. All alterations made by the company to the machine, all attachments furnished, etc., whether at the time of completion or at a subsequent date are noted on this card. Thus at any time when the number of the machine is known an exact record can be found of just what design each and all of its parts are and just what attachments if any are with the lathe. As a matter of convenience the sales department keeps a cross reference which assists in locating the number of the machine when the customer's name and address is known. The importance of this information in rendering service has already been emphasized. Briefly without such records the service required by customers today cannot be given.

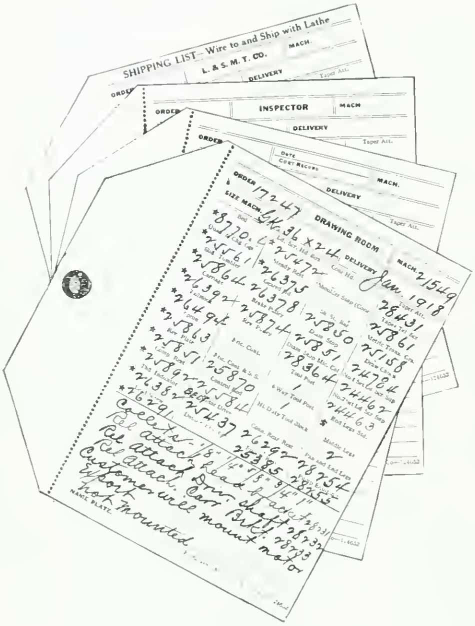

SHIPPING LIST—Wire to and Ship with Lathe
L. & S. M. T. CO.
MACH.
DELIVERY
ORDER
INSPECTOR
Taper Att.
Date
Cost Record
DRAWING ROOM
SIZE MACH.
ORDER 17247
MACH. 21549
DELIVERY Jan. 1918
Collets—1/8" 1/4" 3/8"
Rel attach head bracket 28731
Rel attach. Driv. shaft 28732
Customer will mount motor
Export
Not mounted
NAME PLATE

FIG. 8. MACHINE ERECTION TAG

In Figure 8 is shown a specimen of the machine erection tag used. One of these tags is attached to each lathe for the purpose of indicating all the units used in assembling it. It will be observed that the design numbers have been written under each unit in order to show exactly what style of unit was used. The original is then filed forming a permanent record of that particular machine.

Future of Automatic Machinery

By David R. Shearer

Consulting Electrical Engineer

IN every manufacturing plant, regardless of its use of automatic machinery, there remain many routine operations handled by manual labor which could be done more regularly, accurately and rapidly by mechanical means if the proper equipment were available. Of course, there will always be a necessity for hand work especially in operations requiring a coördination between the muscles and the mind, but the advance in the use of automatic means for the production of a finished output has hardly begun in spite of the rapid growth of the last few years.

There seem to be two tendencies among manufacturers who advocate more mechanical work: The one strives to do all the work possible by machinery and employs skilled and highly trained labor to keep the machines operating efficiently. The other employs as much cheap labor as possible to operate fool-proof machines and dispense with the highly trained employee.

An example of the latter method may be seen in the use of an addressing machine operated by the office boy, to displace the work of a number of typists in addressing circulars or magazines; while an example of the former method may be found in the shop employing one highly trained mechanic to operate a number of totally automatic machines, or machines which feed themselves and deliver a finished product to other devices which transfer and pack the output.

Both methods have their use and their particular advocates, and probably both are necessary from an economic viewpoint, but it appears that the greatest opportunity for development is along the line of more really automatic machinery and less labor of the lower kinds.

Let purely routine work be taken care of mechanically, and employ a few highly trained men to keep the machines at work and in proper repair. A particular advantage of this procedure is that the employees are better educated and more highly trained and so are more amenable to reason and much easier controlled.

As an example of what has been done and to point the way to possibilities in manufacturing methods we have only to consider the automatic substations operating on some of the interurban electric railways. These substations are placed all along the line at intervals of a few miles in order to change the high tension alternating current of the transmission lines into a lower voltage direct current for use on the trolley. Formerly, both a day and a night operator was necessary at each of these substations, but later an automatic equipment was developed which could start and stop itself and perform its other necessary functions without other human attention than a periodic inspection.

When automatic machinery of this kind is placed in operation it is not enough that it should operate automatically under normal conditions, but it must be so designed that it will notify someone, somewhere, if trouble develops or any abnormal operating condition arises. This is absolutely necessary for the protection of the equipment itself and of the product.

Another admirable feature of the truly automatic machine is that being self-protective it is less subject to breakage or burnouts than a machine dependent upon the human factor for its safety.

If highly complicated substations and power plants containing several machines operating in conjunction and each dependent on the other can be made automatic in operation and, in addition, can be made to give notice of trouble or abnormal operating conditions besides protecting themselves from injury, why cannot much of the machinery now in use by manufacturers be made to operate in a similar manner? The aim in the design and development of this type of equipment is that one trained operator is able to handle the greatest possible number of machines each of which automatically turns out a finished product.

Mastering Power Production—I

Development of the Principle of Producing for the Common Good

By Walter N. Polakov

The author shows how the principles and methods of attack of scientific management are based on the philosophy of Bacon and Descartes. "Dr. Frederick W. Taylor was the first to apply the methods of scientific deduction to productive activity. The great work of Mr. H. L. Gantt has been to show how the scientific control of production can serve humanity." Following installments of this series will show in detail the application of these principles to the generation or production of power.

Mr. Walter N. Polakov *is a consulting engineer specializing in the management of power plants. He was educated in Russia and Germany and held a position of shop superintendent and chief engineer in Russia and was also instructor and consulting engineer to the Naval Academy at Baku. After coming to this country, and prior to taking up his own practice, he was consulting engineer to the Board of Estimate and Apportionment of New York City, consulting engineer for the Penn Central Light & Power Company and Superintendent of Power of the New York, New Haven and Hartford Railroad.*

In the old order of things the master was he, who had the title to the means of production—the owner of the land, the owner of the tools, the owner of the slaves or of the money to buy the tools, the land and the labor. The owner of the weapons and of skill to wield them became a master of masters, since he had the might to take.

The mode and the purpose of the use of the property remained arbitrary so long as it concerned no one but the owner himself. When, however, the scale on which the production and exchange was carried out assumed larger proportions the ownership of various large means of production and distribution became collective. A similar process is observed in government. The individual potentate or Caesar split into triumvirates and even republics.

As the complexity of productive operations grew with the development of the technique, and the size of the corporate or even the individual holdings increased, the task of managing enterprises required more individual attention and often more skill than the owner of the property title possessed. It thus became necessary to delegate the management of certain branches and sections to the hired men, the owner or owners still retaining the right to prescribe the policy and determine the destiny of the enterprise. A parallel transition took place in the management of national affairs: Kings delegated the ruling of provinces to their vassals or governors.

With the still further development of technique and science even the simplest article required numerous elementary operations in its production. High-speed automatic machinery, and the like, shifted the importance from the performance of the operation to the coördination of a multitude of various functions and a different form of management became necessary. This need was not realized until very recently, and the owners for a long time continued to attempt to delegate the management to men who were supposed to know *how the things are made, not how the productive functions shall be coördinated.*

NINETEENTH CENTURY MANAGEMENT

The ideal of nineteenth century industrial management was to make a workman personally efficient. The modern trade union, unlike the medieval guild, does not need to preserve the secrets of the trade or train the skill of its members, since the operation of modern machinery does not require either from its operator—the first function passed over to the designer and the second to the manager

Mr. H. L. Gantt in his address in 1912 before the Society for the Promotion of Engineering Education said: "Until recently the engineer has regarded his work done, when he has developed and improved machine or apparatus, and proved by operating it for a short while that its capacity was all he claimed for it. It has often been acquired by men imperfectly trained mechanically, but who had the commercial instinct highly developed. Such men usually turn it over to a "cheap" man to operate, and its maintenance is nearly always looked after by a second-rate mechanic, for the commercial man can seldom see why he should have a high-priced man doing repairs. The efficiency of the machine naturally decreases, and a factory run on these principles must necessarily be more inefficient still."

The industrial management of the past century contended that it was the task of the workman to be personally efficient and to use each unit of equipment to the best advantage. Dr. Frederick W. Taylor was the first to apply the methods of scientific deduction to productive activity. The great work of Mr. H. L. Gantt was to show how the scientific control of production can serve humanity.

INFLUENCE OF TWO MASTER MINDS

The influence of these two master minds on industrial progress can be compared only with that of Bacon and Descartes on science. As their theory of induction is the basis upon which the creation of modern positive science was made possible, so the application of these principles to creative activity is the foundation upon which the new industrial relations can be established.

He is not the leader who points out the goal but it is he who shows the way to those who want to attain it. The economic evolution of society goes in a definite direction and it is not within anyone's power to divert or retard the progress. All that can be done to choose the means to reduce the pains and sufferings caused by the transition periods. We must clearly see the way in order to avoid blundering and wandering in the dark. The leader lights the way. "If we clearly see that what we are doing is wrong, it would be impossible for us to do so," says Rene Descartes in his *Oevres*, (IX; 170).

PRINCIPLES OF THE NEW SCHOOL OF MANAGEMENT

To understand the principles upon which the new school of management gets hold of mastering the production and leads the way to the higher forms of industrial and economic relations, a brief review of Bacon-Descartes philosophy is indispensable. The method of finding out the truth for Bacon was that of pure induction—analysis of a phenomenon in order to bring to light the cause of it, supposedly contained in the phenomenon itself. Says he: "whosoever knows any form[1], knows also the utmost possibility of superinducing that nature upon every variety of matter."

In this manner the practical application of discovered truth may begin only after the last step of the theoretical analysis is made. While induction alone, without the inspiration of scientific imagination and use of hypothesis has never led to any discovery, Bacon's method of exclusion and elimination is of immeasurable value. His principles applied to scientific research work smashed all idols of mere authority, time honored opinions or habits. He pointed out two kinds of fallacies: "The proneness to support the preconceived opinions by affirmative instances, neglecting the opposing cases and tendency to generalize from an insufficient number of observations." Those who read *Shop Management* and *On the Art of Cutting Metals* by F. W. Taylor can readily recognize the influence of Bacon on the conduct of these researches, and the value of this inheritance cannot be over-estimated. The second type of fallacies, Bacon exposed and warned us of, are those arising from the influence of mere words on our minds.

The great danger of such semi-hypnotic influence can only be recognized when we stop to consider how often the crowd accepts and follows certain formulas or watchwords, not realizing that they are actually led in quite the opposite direction, that the charm of words has no more meaning under the changed circumstances.

Rene Descartes put the principle of doubt "*de omnibus dubitantum est*" as a corner stone for creative analysis and for practical discoveries.

The method of doubt is at the same time a method of abstraction. To obtain truth we must free ourselves by one decisive effort from the influence of custom, prejudice and tradition which generally obsess our ideas and action to an extent that we are often unable to tell the reason why we do certain things. In practice it resolves into ability to distinguish between an opinion and a fact.

Descartes' method rests upon a proposition that all the objects of knowledge fall into series, in each of them there is a determining element, simple and irresoluble, the other elements of the group are relative and dependent and can be understood as a subordinate to the basic conception. The analysis thus resolves into four groups defined by Descartes as: "1. Truth requires a clear and distinct conception of its object, excluding all doubt. 2. The objects of knowledge naturally fall into series of groups. 3. In these groups investigation must begin with a simple and indecomposable element. 4. An exhaustive and immediate grasp of the relations and interconnexion of these elements is necessary for knowledge in the fullest sense of that word." (R. Descartes, *Discourse of Methods and Meditations.*)

BASIS OF SCIENTIFIC MANAGEMENT

It now becomes apparent that the method of scientific induction applied to industrial and shop problems constitutes the basis of, so-called, scientific management. A French critique of Gantt's principles thus pictures them in the *Revue Metallurgique*: "This is the method employed by Claude Bernard and Pasteur, but Gantt is nearer to the Cartesians. Gantt is too much an American to develop science for the sake of science. The object of scientific investigation is to show to the men a better way to coöperate, in fact to make them happier and to allow them to develop intellectually. . . . This is a point in opposition to German utilitarism. We have somewhat too much forgotten. Gantt and Taine the most conspicuous thinkers of the nineteenth century conceived the changes which the scientific method will bring into organization of society."

The recognition of these principles created interest in scientific management. Many started to imitate forms and isolated features overlooking the basic principles. Room for improvement was so large that even untrained imitators were able to make savings in productive wastefulness. But this was no far-reaching or long lived movement for amateurs. Reconstructed on the sound basis, the art of management of shops and plants shifted the responsibility from the workman to the manager. It is the manager who is now expected to know:

1. What to do.
2. When to do it.
3. How to do it.

As long as the owners continued to trust the management of their affairs to men trained as lawyers or bankers, who still base their claims "upon information and belief," the wide application of the scientific type of management was impossible for the want of necessary training in the use of scientific analysis.

THE EFFORT FOR PERSONAL EFFICIENCY

For a long time the chief concern of the management was the intensification of the personal efficiency of the workman. Time studies and premium plans were originally devised as means to increase the productivity of a workman and to stimulate him to maintain the high rate. In the course of this strife it was realized that unless the management accepts its share of responsibility the workman cannot be fully efficient. His tools, equipment, supplies, materials, surroundings, etc., shall be maintained and kept in such a shape as will eliminate waste of time and effort. But it was only a few years ago, that the new possibilities of intensifying production were conceived. While efforts were abundant to keep the workman productively engaged, little attention was paid to the fact that expensive equipment often remains idle for lack of work, special character of service or poor planning. The financial burden, however, continued to be charged against the cost of product and the consumers were forced to pay the fixed charges on the productive facilities which played no part in the production. Another far-reaching principle came to light still more recently, that of coördination of the productive functions not only within a plant but among various plants. Lastly, under the stress of conditions imposed by the war, the function of distribution and selling of products was separated from purely productive functions and taken care of on a coöperative basis or by the state.

The social importance of these three events cannot be over-estimated:

1. Recognition of non-use or partial use of means of production leads to the possibility of further vast increase of productivity.

2. The method of coördination of productive functions on a national or international basis eliminates duplication of efforts and disorganization, thus enormously increasing productivity.

3. Coördination of distribution does away with enormous loss of efforts in marketing and competition, liberates an army of sales forces for productive occupations, does away with disorganized overproduction, industrial depressions, unemployment and hoarding, and

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[1] Form is understood by Bacon as "nothing more than those laws and determination . . . which govern . . . nature." Thus the form of heat or the form of light is the same thing as the law of heat or the law of light." *Novum Organum*, II-17.

assures to the consumers equitable prices and more liberal satisfaction of wants.

True enough all those possibilities are far from being fully realized, yet the recognition of the principles and discovery of the means whereby the control may be secured[2] marks the dawn of a new industrial era.

Principles Behind Applied Science

It seems to be superfluous to point out here what wonderful progress was made in all branches of pure and applied science since it was based on the principles established by Bacon and Descartes. The chemical, electrical and mechanical discoveries made an enormous production possible with simplicity, ease and speed unbelievable even fifty years ago—talking across the ocean, seeing through flesh, synthetic creation of food, air travel, exceeds the wildest imagination of Jules Verne and tales of a thousand and one nights.

A consistent, thorough application of the same principles to the coördination of productive efforts, to the mastering of production is unquestionably capable of satisfying all conceivable needs and luxuries of the human race. The hours of work and effort can be reduced to a small fraction of that required a few years ago. While all this may sound like a millenium, ample examples of actual possibilities are everywhere. A thinker of the nineteenth century said: "The average daily amount of socially necessary labor is easily ascertained by statistical method. The figures would, furthermore, point out where more plants for the production of a certain article may be needed, or where such may be discontinued as superfluous, or turned to other purposes." (A. Bebel, *Woman, etc.*, page 278).

Democracy Will Yield the Best Industrial Relations

The munition boards and industrial commissions during the world war made this dream true because the method was discovered when the need demanded it. It is the conviction of Gantt that the industrial relations established "on the basis of democracy that will yield as good, or better, results than those now in operation under autocracy" (H. L. Gantt, *Industrial Leadership*, page 53). "A system of management" is defined by him "as a means of causing men to coöperate with each other for a common end. If this coöperation is maintained by force, the system is in a state of unstable equilibrium, and will go to pieces if the strong hand is removed. Coöperation in which the bond is mutual interest in the success of the work done by intelligent and honest methods produces a state of equilibrium which is stable and needs no outside support" (*Training of Workman, etc.*, A. S. M. E., 1908, H. L. Gantt).

The Task of the Engineer

We don't need to shut our eyes to the fact that antagonism of interests between employer and employee does exist, and the Utopia of harmonious relations between these two classes will remain a Utopia until both are absorbed into a new group. Signs of the times are many that public utilities are steadily and gradually nationalized. The same is true regarding other branches of industries and this is evident in all countries of the World. Moreover, it is no longer disputed that the principle of "service to the people first" yields larger returns than the "public be damned." The task of an engineer, called to master production, is that of producing things with the minimum expense of time, energy and material. So long as he is bent over this task, the public at large demands that the industries shall be democratized. Democracy in industry means production carried out for the good of the community. This mutual interest in the result of necessary toil cannot fail but still further enhance efficiency.

"The commercial man," says Gantt, "has not yet recognized that the prosperity of all is directly helped by the prosperity of each. As yet he has no idea of what real coöperation means. This idea of coöperation is that of the herd, whose coöperation is for the attack or defense." Five years later the *London Economist* plainly states that "now after three years of experimentation it is becoming widely realized that we cannot go back to our old free, untrammeled individualism. We can no longer conduct business, each man for himself, each industry for itself, on the principle of devil-take-the-hindmost. Inefficient as is industry under government control and management, yet we have seen how very great was our frictional wastage before the war under our old free competitive system.

By supplementing the element of compulsion in coöperation and management by the democratic spirit of team work for the good of society it appears almost within reach to fulfill the old prophecy:

> A system of labor, organized upon a plan of liberty and democratic equality, where each stands for all, and all stand for each, and where the sense of solidarity reigns supreme—such a system would generate a spirit of industry and of emulation nowhere to be found in the modern economic system. Nor could such a spirit of industry fail to reach both upon the productivity of labor and the quality of labor's product. Furthermore—seeing that all are mutually active—the interest becomes general in the best and most complete, as well as, in the quickest possible production of goods, with the object of saving labor, and of gaining time for the production of further wealth, looking to the gratification of higher wants. Such a common interest spurs all to bend their thoughts toward simplifying and quickening the process of labor. The ambition to invent and discover is stimulated to the highest pitch: each will seek to outdo the other in propositions and ideas.[3]

Frederick W. Taylor was certain that the elimination of soldiering or voluntary reduction of output by workman "would insure higher wages and make shorter working hours and better working and home conditions possible." Far larger possibilities exist in the eliminating the sense of irresponsibility as to the methods and principles upon which the production is carried out. *The revenue producing factor is not the investment but the method of its use.* "The great problem before us today is not that of developing new and better appliances, but that of properly utilizing those we have." (Gantt.)

What use is ultimately made of the returns from the enterprise is not within the scope of this discussion; the immediate question is *what are the principles and the methods whereby the mastering of production can be carried out for the common good of the producers and consumers.*

In the following installments an outline of these principles is given as applied by the writer to one branch of industry—power production.

1. The volume of the output stands in no relation to the amount of labor required.
2. The quality of the work stands in nearly inverse relation to the physical effort applied.

While these two characteristics are more pronounced in the field of power generation than in other branches of industry they are highly significant, inasmuch as further automatization of productive machinery gradually eliminates the manual work, the product of which is a direct function of time, skill and effort. In this sense the principles that stood the test of application to the power-plant work are equally applicable to any productive activity where the manual labor is brought to insignificance.

(To be continued)

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[2] Notably the work of H. L. Gantt.

[3] A contest, who can do most for the common good, is not the kind of a competition which socialists repudiate, John Stuart Mill, *Principles of Political Economy*.

The Employees' Benefit Association - I

How to Solve Its Problems and Operate it Successfully

By W. L. Chandler

The author has made a study of the organization, development and operation of some 579 industrial mutual benefit associations. His results are presented through the answers to seventy problems, of which this first installment discusses thirteen. The series will be of especial help to all executives who are trying to build up this phase of labor-maintenance work in their plants.

Mr. W. L. Chandler *has had experience in every department of the plant of The Dodge Manufacturing Company. Of late years he has specialized on the study of employees' relations. He has been identified with many local and national movements, and was chairman of the Danger Emblem Committee of the National Safety Council and is now chairman of a committee of the Nat'l Association of Purchasing Agents.*

"SOMETHING should be done to stimulate interest in the relief association. Not enough of the men appreciate its value to them, and without the presence of genuine interest on the part of more of the employees its value to the men and to the corporation are both greatly reduced."

That was the general opinion of officers of the Dodge Manufacturing Company a few years ago. The Dodge Mutual Relief Association was approaching the close of the twenty-fifth year of its existence.

At that time it was decided to investigate the situation to see what could be, or should be, done to put the association on a better basis where it would benefit all concerned as a tribute on the occasion of its silver anniversary.

A questionnaire was sent to over five hundred corporations which were supposed to be operating similar organizations. Later this research work became quite a hobby. The Dodge organization was used to test out certain conclusions reached after analyzing the data compiled from these sources, together with a quantity of information supplied by the Commissioner of Labor.

Various questions or problems were to be solved. Most of these pertain as much to the organization of new associations as they do to the reorganization of old ones.

Many associations now in existence would be very much more effective if they were modified to embody more of the features which have proven successful elsewhere. The benefit association will not develop itself. It requires as much thought and attention as any other activity of either men or corporation that the best results may be secured. Reference to the fourth paragraph of problem Number 9 will show one reason for careful consideration of these problems.

Seventy problems are brought together in six general groups to be treated serially in the columns of INDUSTRIAL MANAGEMENT, of which this is the first installment.

SHOULD WE UNDERTAKE INDUSTRIAL INSURANCE?
PROBLEM NUMBER 1

The term industrial insurance covers all forms of insurance protection which pertains to workers in the industries. Employees' benefit associations constitute one form of industrial insurance, although many avoid the use of the word insurance in this connection for fear that they might in that way become involved in some insurance laws.

It is not usually a matter of the corporation or employer undertaking insurance, but merely their coming to the assistance of such an organization within the ranks of their employees.

If employees were banded together for the purpose of increasing their efficiency the employer would not hesitate to point out to them all possible stumbling blocks so that such an organization might be as effective as possible. A benefit association does, beyond any possible doubt, increase the efficiency of all its members.

It is to the interest of the employer to make the association as popular as possible that its effectiveness may be increased.

These associations regularly pay benefits for both sickness and accident disability and for death. The next question is, should the members be given the advantages of their collective operations in handling benefits covering wives and other dependents.

The employer's interest in this problem is twofold: The humanitarian assistance to those who will accept it, and the increase in satisfaction the members feel in the association and, therefore, in the employer.

Employees are now able to insure their dependents in stock companies by paying small amounts weekly. This form of insurance, while wonderfully beneficial to those who take advantage of it, is necessarily expensive because of the cost of both selling and administering.

These industrial policies are usually small, and premiums are said to average about nine cents each per week. When we consider the necessarily high cost of such small policies and add to that the expense of sending a collector to the house each week to collect a premium of a few cents, we have a strong argument in favor of making it possible for members to insure their dependents in their own organization. The cost of administration of the association is very little increased by insuring dependents, because premiums come through the payroll by merely increasing the amount of dues collected.

Sales effort along this line is just as necessary as when the business is handled by stock companies, except that the association has many sales advantages, and can sell with less expense.

The stock companies have one advantage in that the policy issued is valid regardless of place of employment.

A member insuring his dependents in an association of this kind would have one additional reason for sticking to his job, and thus this form of benefit may help reduce the labor turnover. If it will do that, it will be well worth the effort to both employer and employee.

PROBLEM NUMBER 2
THE PROPOSED ACT PERTAINING TO COMPULSORY HEALTH INSURANCE

It is not necessary to reproduce the tentative draft of the act as offered to the various state legislatures. Those not already familiar with this movement should secure copies from the American Association for Labor Legislation, 131 East Twenty-third street, New York City.

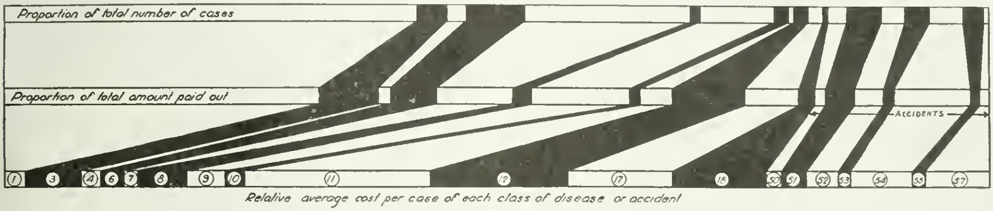
In addition to this booklet considerable interest centers around the proceedings of the conference on Social Insurance, December 5 to 9, 1916, Washington, D. C. For copies of these proceedings write to the Bureau of Labor Statistics, Washington, D. C.

Problem Number 3

Is It Profitable for an Establishment to Have an Employees' Benefit Association Among Its Employees?

The answer to this question depends upon the attitude in which one approaches the question. We may see a moral in the vain efforts of some individuals who, desiring to advance in society, politics, lodge work, or business, resort to practices which "play to the gallery" merely because they believe such practices "pay" or because they have seen some successful man make use of what they believe to be similar methods.

RELATIVE SERIOUSNESS OF VARIOUS CLASSES OF DISEASE AND ACCIDENT
Showing frequency and proportion of total and average costs.
Disclosing the lines along which preventative effort can be made most profitable.



(1) MISCELLANEOUS DISEASES, (3) BLADDER—KIDNEY, (4) BRONCHITIS—PLEURISY, (6) EYE—EAR—NOSE—THROAT, (7) GRIPPE—COLDS, ETC., (8) PNEUMONIA, (9) RHEUMATISM—LUMBAGO, (10) STOMACH, (11) TUBERCULOSIS, (12) TYPHOID, (17) HEART, (18) RUPTURE, (50) BRUISES—CONTUSIONS, (51) BURNS, (52) LACERATIONS, (53) SPRAINS—STRAINS, (54) FRACTURES, (55) MISCELLANEOUS ACCIDENTS, (57) LOSS OF EYE

Any employer who goes into welfare or service work MERELY because it pays, is doomed to disappointment. The employer who reaps the greatest benefit from service work is the man who can remain close enough to his employees to know their needs; and who is willing, from his greater experience and with his greater facilities to counsel, guide and coöperate with them; who will not hesitate to assist them by providing, when necessary, club house and other facilities which might be classed as fixed assets. While the employer may not always have available the time necessary to keep in close personal touch with every detail of association activities, he may select some employee with the proper instincts to devote some part of his time to the service.

Executives all too frequently fail to comprehend fully the viewpoint of the mass of employees with which they have to deal.

In this connection, I wish to present some thoughts expressed by Dr. Charles P. Steinmetz, at a meeting of the National Association of Corporation Schools.

> One feature which is very marked, is that probably more than we generally anticipate, there is a lack of understanding of the mental attitude of the successful executive on the one side, and the mass of his subordinates on the other side. Not ill-feeling, but incomplete understanding of the viewpoint of each other.
>
> We can realize the reason for this when we consider that the temperament of the successful executive is not the typical temperament of the human race. When speaking of the executive, I use the term here with the same meaning as it has been used before, in the meaning accepted in speaking of executives of public and private corporations. That is, not the man who merely carries out the instructions, executes them, but the man who selects and decides what shall be done, whether in an individual case or in the general work of a department; who decides how to carry it out and selects the means, including persons, and sees that it is carried out.
>
> Such action, in addition to the knowledge of the business or the industry which is covered by the work, requires initiative—the ability to act independently as an individual, not as one of a group or mass doing what it is the custom of all to do, but to act individually for himself on his own initiative, irrespective of others.
>
> In other words, in the executive, individualistic temperament is the fundamental requirement of success.
>
> The typical temperament of the human race is not individualistic but collectivistic.
>
> The executive is not, therefore, a typical human individual, but is a variation from type. The result, therefore, is that it is more difficult for the executive to understand the mental attitude of those subordinate to him, and rather difficult for those subordinate to him to understand the attitude of the executive. But to get that understanding is necessary for efficiency, as efficiency is based on coöperation between the executive and his subordinates. Coöperation requires first of all a mutual understanding. That is the weak point inherent in executive positions; there must be mutual understanding and the executive, to be successful, should be a variation from the racial type of men, and therefore finds it difficult to understand the racial mental attitude.

Several employees' social clubs exist where officers and employees hold membership and participate in a spirit of good fellowship in the various activities of the clubs.

Such getting together as may be possible in the factory, together with the social contact thus obtained through real service work permits the employer to know the "other side," and, in fact, leads towards a condition where the so-called "other side" fails to exist.

An employee who is proud of the relief association, the corporation band, the savings fund, the ball team, etc., must have a degree of pride in the organization that is back of them.

If a strike occurs in such a plant, it merely indicates that some unfavorable influences have overbalanced the favorable ones. Service work will never remove all causes of dissatisfaction, but will serve as a cause of satisfaction to offset greatly the effect of little differences of viewpoint which come up from time to time.

The degree to which employers and employees become interested and active in relief associations and other service work, determines the measure of success of the work.

The following calculations are made from figures given in the year book of the American Museum of Safety and credited to Dr. F. L. Hoffman, the eminent statistician.

Among 33,500,000 industrial workers of the United States, there are over 13,000,000 cases of sickness yearly. This is an average of one case of sickness for each three workers, representing over 285 million days of sickness—an average of eight and one-half days per worker. We have here an economic loss to the country of $772,000,000 yearly, or an average of $23 per worker each year.

I quote as follows from the year book:

> One-quarter of these cases of illness are preventable, and are largely a result of the occupations.
>
> In other words, it is within our power to prevent over three million of these cases of sickness yearly, to save over 71 million lost days and prevent the resulting waste of over 193 million dollars.
>
> In view of these enormous figures, together with the losses we know are sustained from injury and accident we need no longer doubt that the most important economic movement under way in America today is the movement for the conservation of the human resources of the country.

An employer who feels that he wants to help eliminate some of this economic waste will find an employees' benefit association a splendid means to that end.

A general survey of many associations disclosed no case where an employer considered the association other than a desirable thing for the establishment. In most cases, those who had operated such associations were very favorably inclined toward them.

In these days of the scarcity of labor, every convenience that will increase the appeal of a plant to the employees will help steady the force and will reduce the turnover of labor which is the source of much loss.

To be thoroughly effective, an association must be noticeably sound and efficient and command the admiration of the employees. If they are enthusiastic about the association, they will be enthusiastic about the plant behind it.

PROBLEM NUMBER 4

SHOULD EACH ESTABLISHMENT HAVE ITS OWN BENEFIT ASSOCIATION?

If the purpose is to acquire data for use later in molding the health insurance laws, it is better to have but one association for a community. Such an organization will help to hold labor in that locality.

Flint, Michigan, has a joint organization with which most local employers coöperate and it is apparently very successful.

On the other hand, a successful individual association exerts a great influence for good in a plant, and will more than compensate for the extra trouble of its separate operation.

Later, when the compulsory health insurance movement becomes established, it may be found necessary to merge several separate organizations, but that need not interfere with individual operations at the present time.

PROBLEM NUMBER 5

CAN A BENEFIT ASSOCIATION BE MADE SELF-SUPPORTING?

In scanning the reports of 579 associations under observation, no evidence was seen indicating that any of them had trouble to sustain themselves without assistance. Four cases were discovered where associations had previously existed and disbanded through lack of interest or because malingering was allowed to ruin the organization. No cause of failure was found which need be considered here except one, and that indicates clearly that the employees need assistance from someone who is familiar with the handling of the problems which continually come up.

This assistance should not partake of paternalism, but should be in the nature of consultation service with a constant effort to show the association officers the reasons underlying the advice given so that they may weigh the advice and make their own decisions.

The membership of all associations averaged 48 per cent. of the total number of employees eligible for membership, but the relative effectiveness of plans whereby the employees manage with and without assistance is shown clearly by the following average figures:

When employees managed alone, 30 per cent. of eligibles enrolled; when employees and employers managed jointly, 66 per cent. of eligibles enrolled; and when employers managed alone, 75 per cent. of eligibles enrolled.

Some establishments consider these associations sufficiently important to them that they absorb all costs themselves. Others provide medical supervision of all employees, not so much to supply the treatment as to detect disease in its incipiency and to see that it is promptly and properly treated. In this way the association members benefit and the corporation has a more efficient force.

The Commissioner of Labor is authority for the statement that only 1.7 per cent. of the funds have found themselves in financial straits during the year under observation. Of this small percentage, one doubled dues for a time, due to an epidemic, while others borrowed money or sought donations for various reasons.

The general consensus of opinion of those who have tried them seems overwhelmingly in favor of the maintenance of these associations.

The important point in mind always should be:

PREVENT THE LOSS DUE TO ACCIDENT AND DISEASE RATHER THAN REIMBURSE FOR THE LOSS AFTERWARD.

In the case of a small establishment, some problems of financing and promotion arise which are taken up later.

PROBLEM NUMBER 6

CAN A SMALL SHOP SUPPORT AN ASSOCIATION?

Small establishments very naturally hesitate to attempt the operation of an association. The following data may prove of interest to them.

One establishment with 45 employees has 31 members (69 per cent.) in its association. This is a harness factory and the association has been successful. Dues were remitted for ten months during the year under observation because there was more than $100 in the treasury. There was no contribution from the establishment and no source of revenue except from members. In this association, dues are $3 per year with an entrance fee of 25 cents and an assessment of $1 at the time of each death, to provide a death benefit. The temporary disability benefit is $5 per week for ten weeks, and a death benefit raised by an assessment of $1 per member, but no other benefits are provided for. They suffered no death losses during the year. If the experience of all associations can safely be used as a guide, they should expect a death about every third year in a membership of 50.

Their experience is much more favorable than the general average. It is not advisable to start a new association with the expectation of having such a favorable experience. Ten establishments with between 50 and 100 employees each, have associations which average 83 per cent. in membership; a very satisfactory showing. Three of these establishments contribute certain amounts to their associations when claims arise; such contributions averaging for one year 48 cents per member of those three associations.

Two of the above three associations use the assessment plan instead of dues; both pay death benefits of $50; one pays temporary disability of $5 per week (which is increased by the establishment to $7) for ten weeks; the other pays no temporary disability benefits, but pays $50 for death of a member, $30 for death of a wife, and from $10 to $25 for death of other dependents according to ages. The regular assessments are, in one, ten cents for sickness, and $1 for death, and in the other, 50 cents for death of member or dependent (the establishment contribution helping out).

Eight associations of establishments having less than 100 employees each have dues and no assessments. They average $5.92 annual dues per member, the highest being $12 per year. Entrance fees are charged by four of these, ranging from five cents to $1. No permanent disability benefits are paid by any of the ten associations; seven pay temporary disability benefits averaging $6.70 per week for periods averaging 15 weeks. Two of these seven pay a secondary temporary disability benefit averaging $3.25 per week for 26 weeks, one of these two received contributions (averaged 36 cents per member in one year) from the establishments and pays $75 death benefit; the other pays no death benefit and received no contributions.

One association without assistance pays $100 death benefit and $50 for death of wife or other dependent; three pay no death benefits, while seven pay an average death benefit of $59.44.

Four associations pay benefits for death of wife ranging from $30 to $50, and for deaths of other dependents ranging from $10 to $50. The following table shows the relation of membership to size of establishment, and in the last column reflects the success of smaller institutions.

TABLE I—ENROLLMENT IN SMALLER PLANTS

Number of employees in establishment.	Number of associations.	Per cent. of total Number of associations.	Number of employees in establishments combined.	Number of members in associations.	Per cent. of employees enrolled.
Under 50	1	....	45	31	63.88
50— 99	10	2¼	770	641	83.25
100—199	63	14	9361	5840	62.45
200—299	36	8	8769	5161	58.85
300—399	47	10	16395	6310	38.48
400—499	34	7	15525	7144	46.00
500—749	38	8	24213	11568	47.77
750—999	43	10	36560	16088	40.00
Total	272	59¼	111638	52783	Aver. 47.5

Some establishments, both large and small, are using various plans whereby employees insure in mutual and stock companies. In some cases, the employers pay a certain proportion of the cost, and in most instances, use considerable effort to induce the employees to insure.

From an actuarial standpoint, a small establishment is at a disadvantage. However, the proposed plan of compulsory sickness insurance, with district funds under state supervision, will prove a great help to those who feel that they are unable to successfully conduct an association among their own employees.

For further information regarding the compulsory plan, see Problem Number 2.

Problem Number 7

Are Associations Practical in Large Cities?

The practicability of associations has been decided in the negative by some establishments located in large cities. There is nothing, however, to indicate that any of these opinions are the result of experiments.

The statistics available are in such form that it is difficult to arrive at accurate figures, but many of the successful associations are located in large cities. In fact, one having an enrollment of 95 per cent. of the employees, is in Philadelphia.

Undoubtedly difficulties of management are greater in large cities than in smaller centers. Facts indicate that associations may be operated successfully in large cities as well as in smaller ones, provided the establishment is willing to supply the requisite amount of energy. Probably the benefits to an employer are enough greater in large cities to justify the extra energy required. At any rate, the turnover is greater in cities which gives greater opportunities for improvement due to the influence of the association.

Problem Number 8

Will Workmen's Compensation and Compulsory Health Insurance Interfere With the Employees' Benefit Association?

Many compensation laws, while they provide medical attention for work accidents from the start, pay compensation only for accidents causing more than one or two weeks' disability. Benefit associations frequently pay after a waiting time of from one to six days. As these associations are maintained by contributions of the men, there is no objection to their carrying protection covering all sorts of accidents and sickness in addition to compensation, particularly during this first period not covered by compensation.

Compensation payments combined with benefits from the association should not exceed a man's usual income; in fact, they should be slightly less, to discourage malingering.

This point is covered in the by-laws of the Dodge Mutual Relief Association by providing that benefits shall be so restricted that income *from all sources* shall not exceed ninety per cent. of usual wages. (Art. VIII, Sec. 4.)

> Section 4. Members of this Association may each take the various benefits at the corresponding rate of dues, provided that no member shall receive from all sources temporary disability benefits in excess of ninety per cent. of his average wages for the three months preceding disability.

Compulsory health insurance, old age pensions and invalidity insurance are undoubtedly on the way, but before we can act intelligently on such questions, we need the data which can be acquired through a benefit association.

Problem Number 9

Should Membership Be Compulsory?

Fifteen per cent. of the associations have more or less compulsory membership. Some of these excuse certain specified persons, such as office clerks, boys and girls; those employed before the date of organization; those earning less than a specified sum, etc.

Twenty-five per cent. of compulsory associations were managed by employees, showing how strongly they were endorsed by the establishments in making membership compulsory. Fifty per cent. were managed jointly by employees and establishments. One association writes that they had a 95 per cent. enrollment before making it compulsory. Some establishments having pension funds, require membership in the benefit associations to entitle employees to pensions thus stimulating membership in the benefit associations.

Building up a membership in an association is nothing other than the sale of insurance. One way to sell it is to compel all employees to buy it. In addition to the unsatisfactory psychological effect, this method is like catching fish by dynamiting the river. It seems much more businesslike to provide insurance that embraces those features which make it worth while and then proceed to sell it on its merits.

The need for managers of the associations, who are familiar with the sales' viewpoint in selling memberships, is reflected in the fact that where employees managed they sold to 30 per cent. of the eligible employees;

where employees and establishments managed jointly, 66 per cent. enrolled; and where the establishments managed alone, 75 per cent. enrolled. Percentages of individual associations range from 2½ to 100 per cent., the general average being 48 per cent.

The great difficulty encountered is the constant changing of employees. Practically one-third of 342,000 members changed during the year. In 92 per cent. of the cases, this was due to employees leaving the establishments. In spite of this, the associations had an average membership 9 per cent. larger at the close of the year than at the start.

One bonus plan is in successful operation in a few associations, whereby the establishment pays an additional benefit for temporary disability of one dollar per week, provided membership is over 80 per cent. of those eligible, and two dollars per week if 90 per cent. is exceeded. Where this plan is working, the memberships exceed 95 per cent. Observation indicates that no plan will stimulate membership unless some one keeps the interest alive by constant effort.

In a bonus plan, dividing large establishments into departments brings each man's responsibility close home to him, and avoids that helpless feeling that he is tied down by some department which he cannot influence.

An employer desiring to induce a large membership may well consider a bonus system of some sort covering high percentage of membership.

Instead of a bonus of benefit only to those suffering disability, a better plan might be to offer to pay some specified amount of dues of all members in departments having reached prescribed percentages so that each member will participate in the bonus.

The experience of the Dodge Association and others with sales methods in use indicates that a consistent, enthusiastic sales effort by the secretary will result in about seventy per cent. as a general average without any other special effort on the part of individual members or of any bonus plan.

To stimulate individuals to secure members, an employer might well offer to pay during every quarter, or month, as desired, one week's dues of all members in departments with an average membership during that period of eighty per cent. of those eligible to join and two weeks' dues in departments exceeding ninety.

Experience with such a bonus plan shows that it works only when the secretary keeps it in the limelight.

Consider the enthusiasm which must follow the effort of employees to get everyone to join the association and the unconscious interest thus stimulated in the employer behind the association. Compare such enthusiasm with the lack of interest of employees where membership is compulsory.

Investigation has already shown that compulsory membership frequently has resulted in placing a board of directors and a secretary in office who gradually drift to the attitude of autocracy, and enthusiasm, if it ever existed, soon vanished under such influences. It is through enthusiasm that the employer derives the greatest benefit in loyalty to him.

In offering a bonus of this sort, it must be one which can readily be visualized by all the men regardless of nationality or education.

ALL contributions of the employer should be conditional upon some performance within the power of the men, so that they may EARN the bonus, and it must be such that each and every member may benefit directly. A man can see a contribution toward his dues, but does not count on being sick or dying, therefore does not visualize the contribution to the general funds, or increased benefits payable to disabled members only.

PROBLEM NO. 10

SHOULD ANY EMPLOYEES BE EXCLUDED FROM MEMBERSHIP?

About 75 per cent. of the associations do not exclude any employees; 12 per cent. exclude females (four of these exclude married women only); 8 per cent. exclude colored persons; 4 per cent. exclude those not working in certain specified departments; 4 per cent. exclude those earning less than specified amounts; 3 per cent. exclude those employed in certain specified (usually hazardous) occupations; 4 per cent. exclude a variety of persons, such as officers, superintendents, foremen, salaried men, those living out of a certain district, those not citizens of the United States, those not belonging to a certain labor union, those belonging to any labor union, those of certain specified nationalities, boys whose fathers are members, and apprentices. Some associations, where they have more than one restriction, are embraced in two or more of the percentages shown above.

It seems unfair to exclude any fellow employee, and especially so if it would be possible to arrange a special rate on actuarial principles to enable the association to carry any risk moderately more hazardous.

Why not then provide various classes of memberships for special cases with rates based on relative costs or make an agreement with the applicant to exempt the association from loss due to any ailment contracted prior to joining the association, if such ailment is suspected.

Article III, Sections 10 and 11, Dodge By-Laws

Section 10. In case that it shall be found that an applicant, his wife (or dependent husband) or child, has a chronic or other ailment which would decrease the desirability of the applicant as a member, the applicant may, by a majority vote of the Board of Directors, be admitted to membership by exempting the Association from liability for such ailments or from liability due to ailments for which such conditions shall be responsible.

Section 11. Whenever an applicant is admitted to membership in accordance with Section 10, the action of the Board of Directors shall be recorded on the membership record as well as in the minutes of the meeting.

PROBLEM NUMBER 11

SHOULD MEMBERSHIP BE RESTRICTED AS TO SEX

Only eleven associations were found which make specific reference to the sexes in their by-laws. These have different classes of memberships based on sex with corresponding dues, benefits, etc.

Females constitute 10 per cent. of the entire membership of all the associations, and 11 per cent. of those who make special provision for female members. Of associations located in establishments employing in excess of five females, 56 per cent. show some evidence of admitting them to membership. Considering the probability that those not making any distinction would permit members of either sex, it is safe to assume that very little distinction is made where females are employed.

Several associations have reported greater difficulties in administering the sick benefits for females, but I cannot see that there is any reason for not admitting them to membership under proper provisions.

A waiting time of three days eliminates disability of the sort which leads to some if not most of the trouble complained of in this connection.

PROBLEM NUMBER 12

SHOULD ANY DISTINCTION BE MADE BETWEEN SALARIED EMPLOYEES AND DAY WORKERS?

The general practice seems to be to make no distinction between salaried and wage-earning employees. If all members pay equally, they should share equally without regard to outside means or other revenue, just as they would in the case of any outside insurance protection. There is one point, however, which must be guarded against in a case where a man is earning more when sick than when well, and that is the temptation toward malingering.

If salaries are continued during disability, it is perhaps unwise for an association to pay disability benefits too, but benefits may start after salary stops and continue for the stipulated period, so that a salaried man may be covered beyond any short period during which the salary may have been continued.

Under such a plan, salaried members will prove profitable to an association.

Death benefits should be paid without discrimination.

Problem Number 13
Should an Association Be Managed

(a) By employees alone?
(b) By the establishment alone?
(c) By both jointly?
(d) By a managing board?
(e) If by a board, how select it?

After a plan is settled upon, the most essential thing is a capable business management. An association is or should be a regular business proposition. It will not run itself. While it will struggle along with some degree of success even with very indifferent management, to reap the full benefits to both employer and employee, it must be managed by one or more people who are able to sell the insurance service to a high percentage of those eligible for membership, and able to maintain its operations on an efficient basis.

Much that has been said under Problem 9 applies here also. It is very evident that associations need encouragement from the establishments. Some receive very substantial support, while other establishments argue that the employees should not be interfered with. There is a vast difference between assistance and paternalism —between intelligent coöperation and interference.

In comparing the reports of associations, it is possible to pick out those where the association officers are working along as best they can without the assistance of the establishment, as distinguished from those where the employer, by his interest, sets the pace for all foremen and others who can boost.

Two cases were found where associations disbanded largely because the officers chosen were not enthusiastic, did not sell the insurance, and did not manage the affairs on a business basis.

Seventy-five per cent. of the associations are managed by employees alone, with or without the advice of the employer; 7 per cent. by the establishments, and 18 per cent. jointly.

The plans of administration of the associations vary from placing one individual in authority, to a complex form of representative government. Nearly two-thirds of the associations have managing boards which predominate in or control the affairs of the association. Those boards usually consist of from two to ten members, but some of them have a much larger membership, due to providing representation from departments, etc.

In 72 per cent. of the associations having managing boards, members of the board must be employees; in 2.3 per cent. of the associations they must be establishment officials; in 10 per cent. they must be divided between employees and officials and in 8.3 per cent. they may be either employees or officials. Of the associations having boards, 7.4 per cent. do not indicate how the boards are made up. Possibly these may be assumed to be in the class with those where the board members may be either employees or officials. In this case, the percentage for that class will be 15.7 per cent. instead of 8.3.

In 56 per cent. of the associations having managing boards, one or more officers of the association are ex-officio members of the boards. In 68 per cent. of the associations having boards, the employees elect all the board members; in 12 per cent. the boards consist of certain officials or employees designated by constitutional provision; in 5.6 per cent., the board is elected by the employees and part appointed by the establishment, in 3.6 per cent., the board is appointed by the president; in 2.3 per cent., they are appointed by the establishment, and in the remaining 8.5 per cent. they are selected in various other ways.

In 74 per cent. of the associations electing boards, elections are held annually; in 16 per cent., at stated intervals, ranging from six months to three years, and in the remainder the terms of office are irregular.

All corporation officials or employees should be eligible for election if sufficiently interested to become members, and if competent to advise and vote with the interests of employees at heart. If they have the correct viewpoint the members will welcome their advice.

Additional groups of problems together with other charts and tables will appear in succeeding issues of Industrial Management.

(To be continued)

British Housing Problems

By I. W. Chubb

The provision of housing on an extensive scale, especially for workmen, will be one of the biggest tasks which Great Britain will have to face during the period of reconstruction following the war. It is estimated that at the end of the present year there will be a shortage, due to cessation of building, of about 200,000 houses, and that this number will in all probability rise to 300,000 by the end of 1918.

The work to be undertaken, if urgent necessities are to be met within a reasonable time, is obviously one of great magnitude. Hitherto the largest number of cottages erected in any single year has never reached 50,000. A program of construction involving double that number must inevitably strain the productive power of the country to its utmost limits, especially when undertaken at a time when there will be irresistible demands for the alteration, extension, and for other essential work of a similar nature in industrial plants.

One of the chief difficulties to be solved will be the provision of an adequate supply of building materials. Realizing that this problem must be tackled without delay, Dr. Addison, Minister of Reconstruction, has appointed a committee to consider and report on the whole question of ways and means. The committee will inquire into the extent of the probable demand for building materials for all purposes during the transition period, and report what steps are necessary to insure that the manufacture of these materials, so far as they are at present inadequate, will be extended in time to secure sufficient quantities for a prompt commencement of building operations on the cessation of hostilities.

How much will have to be done in this direction may be judged from the fact that if the building of 300,000 cottages of the type containing a living room, a kitchen and three bedrooms were undertaken, there would be required approximately: 6,000,000,000 bricks; 500,000 tons of cement; 600,000 tons of lime; 120,000,000 slates; 300,000,000 roof tiles; 2,500,000 windows; 3,000,000 doors and frames; 300,000 staircases; and 23,400,000 square feet of glass.

Bringing Capital and Labor Together

A Plea to Prepare for the Coming Rearrangement of Prices

By J. P. Brophy

Mutual distrust must disappear before capital and labor can negotiate and agree upon hours of labor, wages, working conditions and all other points in which both have interests. The author suggests a board of control to determine such matters, and counsels employers to remember that the world is not made for a few but for the multitudes.

Mr. J. P. Brophy *has had a varied and extensive experience in machinery building and is now Vice-President and General Manager of the Cleveland Automatic Machine Company. Coming as they do from a prominent manufacturer his articles in the technical press have been widely read and favorably commented upon.*

WHEN you and I talk concerning capital and labor, we are speaking on a subject of vital importance and one nearly as old as the hills. And after all is said and done the employer and employee seem to be as far apart at this time as they have ever been, although the need of coöperation was never greater. Is there no way of bringing closer together the man who works and the man who supplies the cash to carry on the business? Is there a possibility that workingmen expect more than their output deserves, or is it possible that employers are expecting too much. It is a most difficult problem to analyze, but from the writer's experience he is strongly under the impression that the present state of affairs will continue until some new way of treating the difficulty is discovered.

The business man who carefully and cautiously endeavors to use every dollar of investment to the best advantage, by purchasing property, adding buildings, equipping them in the most efficient manner, and finally becomes successful to the extent of controlling a business, deserves more credit and more sympathetic understanding from the men who work than he usually gets. When this man starts in a humble way, perhaps having previously been employed in the ranks, enmity against him from men who were previously his friends, is noticeable. Jealousy creeps in because of his advancement day by day and year by year as he surmounts the obstacles in his path and finally reaches the top.

TO INDUSTRIAL MANAGERS:

Remember, the great masses of the working people think they are abused.

Remember, the world was not intended for the few but for the multitudes.

Remember, even though you are a successful business man that you should not use your powers to antagonize.

Remember, loyalty must be recognized. Praise for exceptional efforts is all right so far as it goes, but an increase in pay when deserved is the expected and honest way to reward a loyal worker.

Remember, wages fluctuate and always will, so be prepared when business is above or below normal, to meet the conditions.

The Risks of Business

It is well understood by those who aspire to better things that, when a man takes risks, in the beginning he is considered by a great many as freakish and if he is a failure he is called a fool. But what would we do if it was not for this intelligent and daring individual? The great business enterprises in this country would never exist. We have to work to live and the so-called rich man—the industrial executive and employer—is our real salvation.

The laborer is too apt to think and say that the world owes him a living and he is going to have it at all hazards.

Such thoughts embitter, disturb and destroy all that is necessary to bring closer together the great mass of human beings. The troubles of ninety per cent. of those who employ labor today would be lightened, if those in their employ would take into consideration the fact that the man at the head has his troubles in abundance, and that the great majority are willing and even anxious to pay the best wages when satisfactory results are obtained.

The Fallacy of Restricted Output

The great mistake made by labor is to imagine that to do as little as possible and get away with it is smart. This is nothing less than an illusion, a fallacy, and interferes with progress and the development of coöperation.

Capital and labor will never work together in a harmonious manner until after they have acquired greater faith in each other. This great faith can never exist except when the workmen think more seriously about making headway, are careful not to interfere with the advancement of others and admire the fellow who is making good.

It seems that the more you attempt to solve the problem of reconciliation the more tortuous and disappointing your efforts will be because distrust is prevalent. But who is the real sufferer? This is easily answered. The man who produces, he is the man—the one who carries the dinner-bucket, plows, reaps and builds. And this I would say to employees in general, do not think you are always mistreated. Do not regard the man at the top as your enemy but show by word and action real sincerity in studying the question from both sides. If you do, this world will seem a much grander place and sublime contentment will soften our thoughts.

All this does not mean submissiveness on the part of workmen, far from it. The great majority of business men will go more than half way in an endeavor to banish all dislike and improve working conditions.

Just a Little Illustration

Just a little illustration of the one-sidedness of this question. Did you ever hear the good old Democrat say: "I never read a Republican paper, nor would I listen to their speeches. I have always been a Democrat and even if I knew my side was wrong, I am always sure they are right and that is the way I will vote." Or perhaps it is a Republican who says the same about a Democratic paper and its views. Imagine the inconsistency of such a line of reasoning.

Six Things to Remember

To industrial managers I would say: Remember, the great masses of the working people think they are abused. In some cases they are right, but in many cases they are wrong. Keep this in mind and it may help you to get the right attitude to solve some of your future troubles. Use common sense.

Remember, the world was not intended for the few, rich or poor, but for the multitudes.

Remember, even though you may have the heritage of more brains than your employee, he does not think so.

Remember, even though you are a successful man, that you should not use your powers to antagonize.

Remember, loyalty must be recognized. Praise for exceptional efforts is all right as far as it goes, but an increase in pay when deserved is the expected and honest way to reward a loyal worker.

Remember, wages fluctuate and always will so be prepared, when business is above or below normal, to meet the conditions. Be prepared to meet the rise and fall of the labor market and by so doing evade destructive differences.

If employees would, in good faith, agree to use their brains and hands honestly and to their capacity, their wages would be increased commensurate with their increased output. As a consequence employers would sincerely assist in industrial betterment from every standpoint.

Need of Governmental Boards

Employers and employees through the agencies of disturbing thought carry a feeling of distrust that can never be done away with, in the writer's opinion, except through a Government or State appointed board. Ten to twenty-five business men representing the different industries and the same number of labor leaders might be selected or appointed, with each side contributing to finance this body of arbitrators. Then if differences arose from any source or for any reason, these men would investigate and reach a decision, keeping business conditions in mind constantly. If a dead-lock should be reached, each side might appoint as many umpires as is deemed advisable, or refer to a court of last appeal. Good wages must be paid to such men who will hear both sides and render an honest decision.

Hours and wages should be regulated throughout the Union. This places all lines of business on a basis of equality. Forcing shorter hours and greater pay in one section is an injustice to manufacturers in other sections. Organized bodies of workmen should be held accountable from a real business standpoint. The latitude labor enjoys when on a strike is extremely hurtful to the cause in every instance. Why not find a solution through education and mediation? This would mean concurrent views with an agreement that might be made binding.

Remember, when the war ends, a tremendous re-arrangement of the prices of everything imaginable has got to be undertaken, labor included.

Where is the man big enough to start an educational campaign right now to bring both sides closer together to avoid differences that by and by will be difficult to settle?

Simple Tables Save Mental Labor

By G. W. Greenwood

Secretary, United Fire Brick Co.

YEARS ago I heard a story—very probably untrue—of an indolent boy who made a device to perform this work while he took the time to play. Discovering this, the boss fired the boy but kept his contrivances.

Here, however, is a similar and, in this case at least, a true story. In an office of a large corporation are many clerks checking up and extending meter readings at a few different contract rates. To one of these clerks, whom I knew quite well, I suggested the use of tables and offered to assist him in the preparation of the few which would be required. Seeing how it would shorten his work, he took up the subject enthusiastically only to abandon the plan, lest he should get in bad with the head of the department for taking a short cut in his work.

There are so many places where tables can be used to advantage; and they can be easily prepared. Yet people continue to waste time in the drudgery of calculations, with the constant danger of making mistakes, although the burden is being partly lifted in some cases by the use of calculating machines.

How Tables Help

Here is still another instance with a different outcome: A certain operation was being paid for at the rate of 18 cents per gross ton. (Why do we still use this unwieldy standard?) The cost had to be figured each day, and this is how they went about it. Each evening the clerk added up the total number of pounds, divided by 2240, carrying the division to several decimal places for safety, and multiplied the result by 18. They had been doing this for years.

To eliminate this unnecessary work, we proceed as follows: Finding the least and greatest number of pounds likely to be handled in any day, we prepared tables like the one accompanying this article, Table 1—tables which as we shall see can be easily prepared and the compilation of which is in itself decidedly interesting. The table is compact like a table of logarithms, and it is of the utmost simplicity.

To find, for example, the cost of handling 8,300 pounds, find 8 in the left-hand column, and look along this row of figures in the column headed 300, thus finding 67, the required result to the nearest cent.

One sheet of letter size paper, 8½ x 11, was sufficient, with generous margins and spaces, to hold all the results required, so that one could quickly find any row and any space. For example, the column for 700 pounds is the middle one in the right hand block—no need to look at the top after the first few days of use.

Then there were several other operations paid for in like manner by the gross ton or for an odd amount, thus requiring extended divisions, and similar tables were made for these also.

In addition to the time saved, the number of errors was reduced to a minimum, and these were readily caught by computing totals at the end of each month. With regard to the saving, just figure up for yourself what ten minutes a day will amount to in a year.

How Tables Are Made

Tables of this character can be easily prepared thus:

In the above example, we find the cost of 100 pounds to be a little more than .0080357 with an error of less than one-half a cent in ten million pounds. Suppose we begin with 6,000 pounds. The cost for this is 48.21429 cents.

In an adding machine put 48,214.29, using for the cents columns the first two columns ordinarily used for thousands of dollars, so as to carry our results to the decimal part of a cent to a sufficient number of places. Then insert in the adding machine the cost for one hundred pounds,

803.57

press the repeat key, and we are ready to start. By successively pulling the handle—no other work or thought being now required,—we get the following results:

Number of pounds	Result shown on adding wheels
6,000	48,214.29
6,100	49,017.86
6,200	49,821.43
6,300	50,625.00
6,400	51,428.57
6,500	52,232.14

and so on, the results now being ground out as rapidly as one chooses to pull the handle.

The next move is to set down these results in convenient tabulated form.

Set the tabulator stops of a typewriter, leaving extra spaces between the fifth and sixth columns, and write to the nearest cent the results as they appear on the wheels of the adding machine, forming the table as shown.

Leave additional horizontal spaces between 10 and 11, 15 and 16, and so on in the left-hand column, so that the results appear in blocks five wide and five high, thus facilitating in every manner possible the finding of any result required.

After the first amount was placed in the adding machine and the tabulator set for the typewriter, the preparation of the accompanying table required only about fifteen minutes for a single operator. One expert operator for the typewriter and an assistant to pull the handle of the adding machine, working together can get out such tables with startling rapidity.

In making the above table, the result shown by the adding machine for 11,000 pounds was 88,392.79, whereas the correct result to the same number of decimals is 88,392.86, showing that an error is creeping up on the adding wheels, but so slowly that while for 1,000,000 pounds the added will show 8,035,700.09 (giving to the nearest cent $80.36), the correct result to the same number of decimal places is 8,035,714.29, an error of about one seventieth part of a cent, in accumulating which the adding machine handle will have to be pulled about ten thousand times. Even this small difference can be corrected by clearing the machine and writing the correct result, obtained by independent calculation, for each 100,000 pounds.

Here is something worth knowing in this connection: Use a sheet of carbon face up, so as to print on the back of the same sheet instead of making a carbon copy on another sheet, and the typewritten sheet can then be used for the making of blue prints, so that one can have as many copies as may be desired.

TABLE 1—SPECIMEN TABLE THAT SAVES MENTAL LABOR

18 CENTS PER GROSS TON

	000	100	200	300	400	500	600	700	800	900
6	48	49	50	51	51	52	53	54	55	55
7	56	57	58	59	59	60	61	62	63	63
8	64	65	66	67	67	68	69	70	71	72
9	72	73	74	75	76	76	77	78	79	80
10	80	81	82	83	84	84	85	86	87	88
11	88	89	90	91	92	92	93	94	95	96
12	96	97	98	99	100	100	101	102	103	104
13	104	105	106	107	108	108	109	110	111	112
14	112	113	114	115	116	117	117	118	119	120
15	121	121	122	123	124	125	125	126	127	128
16	129	129	130	131	132	133	133	134	135	136
17	137	137	138	139	140	141	141	142	143	144
18	145	145	146	147	148	149	149	150	151	152
19	153	153	154	155	156	157	157	158	159	160
20	161	162	162	163	164	165	166	166	167	168

Design of Special Slide Rules III.

By A. Lewis Jenkins

Professor, University of Cincinnati

Continuation of a series on the subject published in the November and December issues

The principles involved in the design of special slide rules for the solution of equations involving multiplication and division of variables of different powers, coefficients and the subtraction or addition of constants are exemplified in laying out the axes of a rule for solving the equation

$$z = x \sqrt{\left[\frac{1.25\, u\, (y)^2}{w\, (v-4)}\right]^3}$$

One of the first steps is to determine the sequence of the axes. The sequence shown in Figure 22 is U, V, W, X, Y, Z. There are factorial n (written n) ways in which these axes may be arranged; where n is the number of axes. Hence there are

6 = 6 × 5 × 4 × 3 × 2 × 1 = 720

ways in which the sequence of the variables may be arranged; such as X, Y, V, W, U, Z and W, X, Y, U, Z, V, etc.

The coefficient 1.25 may be combined with any one variable or factored and distributed among any two or more variables. By separating the constant into equal factors it may be combined with the six variables in 63 different ways.

Combining the 720 ways in which the axes may be arranged with the 63 ways in which the constant may be factored and combined with the variables, gives 720 × 63 = 45,360 ways in which a slide rule may be constructed for this equation when the coefficient is equally factored and combined with one or more of the variables, and all of these rules may have the same fundamental scales.

By taking unequal factors of the constant there are an infinite number of ways in which the rule may be laid out.

There is no question but what there are at least a hundred thousand and possibly a million different ways of constructing a rule for this equation such that any two of them would be noticeably different. This accounts for the fact that a great many slide rules have been developed in the past by the "cut and try" method.

Another fact that is worthy of mention is the futility of trying to protect a special slide rule through copyrights or patents. Any copyright or patent on a special slide rule may be easily evaded by simply interchanging two or more of the axes and using different factors of the coefficient.

and are denoted by the subscripts to the letters on the rule.

The U-axis was laid off to a 4-inch logarithmic scale. The V-axis was first laid off to an 8-inch scale as shown by the small figures and then corrected for the — 4 by adding 4 to the numbers corresponding to the first graduation. The W-axis was first laid off to a 4-inch

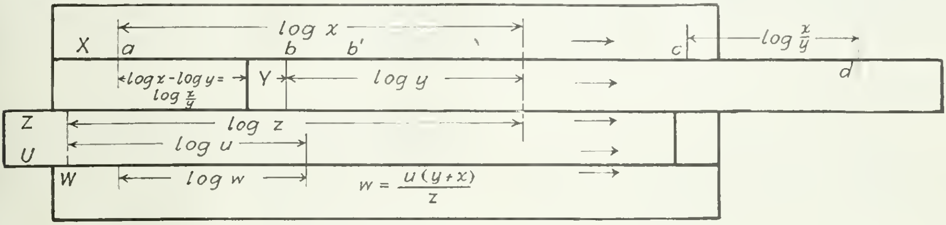


FIG. 27

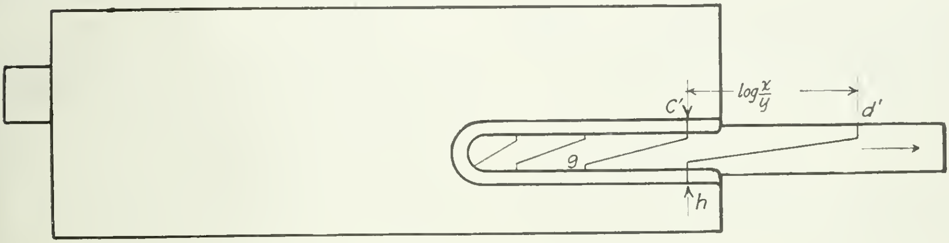


FIG. 28

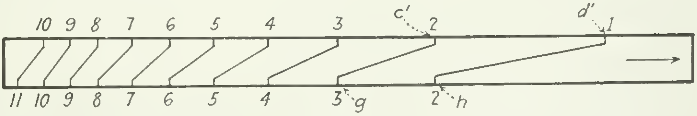


FIG. 29

One way of factoring the coefficient in the above equation is as follows:

$$2.5 = \frac{5}{2} = \frac{10}{4} = \frac{10}{2^2}$$

This gives

$$z = x\sqrt{\left[\frac{10}{2^2}\,\frac{u}{w}\left(\frac{y}{v-4}\right)^2\right]^3}$$

raising both sides to the ⅔ power

$$z^{2/3}\ \frac{10\,u\,(y^2 x^{2/3})}{2^2\,w\,(v-4)}\ 2.$$

The next step is to choose the fundamental scale. S, which is the actual scale of u and w. Taking $S = 4$ and raising both sides of the equation to the fourth power gives

$$z^{8/3}\ \frac{10^4\,u^4\,y^8\,x^{8/3}}{2^8\,w^4\,(v-4)^8}$$

It is seen that the 10 may be combined with the w and the 2 with the y as they are of the same powers. Transposing,

$$\frac{u^4\,10^4\,x^{8/3}\,y^8}{(v-4)^8\,w^4\,2^8\,2^{8/3}} = 1.$$

Figure 24 shows the key to the directions of the axes, and Figure 23 is the rule. The actual logarithmic scales of the axes are equal to the corresponding exponents logarithmic scale; the 1 being opposite the 1 on the fundamental axis of V and then shifted to the right a distance equal to $Sw \log 10 = 4 \log 10 = 4$ inches. Thereby dividing the values of w by 10. The Z-axis was laid off to a $2⅔ = 8/3$ logarithmic scale. The Y-axis is laid off to an 8-inch scale and the 1 has been shifted on the Y-axis an amount equal to 8 log 2, which divides the values of y by 2. The Z-axis has an 8/3 scale and the 1 on the Z-axis is opposite the 1 on the U-axis.

The accuracy of this rule may now be proven by taking any values of the variables such as indicated by the circles and proceeding as follows: Start at 1 on the U-axis and let distances measured to the right be considered positive and to the left negative, and by measuring the actual distances on the rule find the distance that the value of z is from the 1 on U (which in this case is opposite the 1 on Z) and equating it with 8/3 log z. This should give the equation of the rule expressed in logarithmic form. Starting at 1 on the U-axis in Figure 23 the distances are as follows:

$4 \log u - 8 \log (v - 4) + 4 \log 10 - 4 \log w + 8$
$\log x = 8 \log 2 + 8 \log y = 8 \log z.$ Dividing through
$\qquad\qquad 3 \qquad\qquad\qquad\qquad 3$

by 4, the fundamental scale, and writing in the ordinary form gives

$$\frac{10\,u\,x^{2/3}\,y^2}{2^2\,(v-4)^2\,w} = z^{2/3}$$

Substituting the values of $u = 7$, $v = 6$, $w = 50$, $x = 3$, $y = 6$, gives

$$z^{2/3} = 6.55$$

and

$$z = (6.55)^{2/3} = 16.8.$$

Addition and Subtraction of Variables

It is a simple matter to construct a slide rule that will add variables or one that will multiply variables; but in cases where any combination of multiplication and addition or subtraction of variables occurs in the same equation the ordinary methods do not apply. The simple equation

$$y = z\,w - x \text{ or } y + x = z\,w$$

requires a rather complicated slide rule for its solution. This is due to the fact that the addition of $y + x$ requires an equal division axis, whereas, the multiplication, $x\,w$, must be performed with logarithmic axes. Writing the equation in the logarithmic form gives,

$$\log (y + x) = \log z + \log w.$$

It is easy enough to get the values of $y + x$; but special methods are required to find $\log (y + x)$ graphically.

If the values of y and x are such as may be easily added mentally the equation is equivalent to one of three variables, as

$$U = zw$$

where $U = x + y$. This is perhaps the best method to use on a slide rule for such cases as setting time on planer work; the forward and return speeds usually have such values as 40 and 60, 30 and 90 which are easily added mentally.

The values of $\log (y + x)$ may be found graphically by plotting a series of curves between y and $\log (y + x)$ as shown in Figure 26. This slide rule is operated as follows: For any value of y such as at c on the y-axis go horizontally until the curve corresponding to the desired value of x is cut and then down to b. The value of z is then set opposite the point b and the value of w read opposite the value of u. This rule may be conveniently used when the range of the desirable values of x and y are not great enough to require too many curves or too large a diagram. An important objection to the use of this method is due to the difficulty experienced in locating the point b and getting the value of z opposite it.

The rule as shown in Figure 26 solves the five variables equation

$$w = \frac{u\,(y + x)}{z}.$$

Either the z- or w-axis may be used for the coefficient when only four variables are required. If the value of u is made equal to unity, the equation becomes $wx = x + y$.

In Figure 25, x and y are added by using equal division scales and their sum is represented on the fixed equal division axis below the Y-slide. Just below this equal division axis is a logarithmic axis for the same values and the corresponding graduations are connected by "conversion lines." The operation of the rule is as follows: Set y opposite x; opposite the index represented by the arrow trace down the "conversion line" to the lower edge of the fixed axis piece, and set z opposite this point; then opposite u read w.

The rule shown in Figure 27 is provided with five logarithmic axes and a "slip gage" on the back of the Y-slider. This rule solves the above equation in the form.

$$\log \frac{(x + 1)}{y} + \log y + \log u - \log z = \log w, \text{ or}$$

$$zw = uy\,\frac{(x + 1)}{y}.$$

The operation of the rule is as follows: The value of y is set opposite the value of x, which gives $ab = \log x - \log y = \log \frac{x}{y}$. The Y-slider is then moved to the right a distance equal to one unit; if ab is 4, the slider is moved an amount equal to the distance from 4 to 5, or b is moved to b', which is equal to gh on the reverse side of the rule in Figure 28. Then z is set opposite y and w read opposite u.

If the distance between some point d on the Y-slide, and some point c on the frame is made equal to ab in Figure 27 the distance cd will always represent the value of $\log \frac{x}{y}$. The points c' and d' on the reverse side of the rule are directly opposite the points c and d. The reverse side of the slider is graduated logarithmically, top and bottom, to the same scale as X, but in the opposite direction as shown in Figure 29. "Conversion lines" are then drawn, connecting the points on the upper axis with those one unit greater on the lower axis. If the slider is moved in the direction shown by the arrows in Figures 28 and 29 until the point g is opposite c' or h, the distance traversed is equal to $\log \frac{(x + 1)}{y} - \log \frac{x}{y}$ and then, $c'd' = cd = ab' = \log \frac{(x + 1)}{y}$.

The "conversion lines" may be drawn to take care of constants having values greater or less than unity, and in some cases it is desirable to use the form

$$y\,\frac{(Ax + A)}{A\,y} \text{ instead of } y\,\frac{(x + 1)}{y}.$$

When the value of x is less than unity, the value of A should also be less than unity in order to prevent excessive movement of slide when adding constant.

Practical Considerations

A special slide rule should never require a runner.

No slide should be moved after once it has been set, in order that the reading on each axis may be clearly shown when the final result is read. This enables the operator to check the settings at a glance. The rule shown in Figure 27 is undesirable from this standpoint.

The axis representing the variable most sought, or solved for, should be at the bottom of the rule.

Axes should increase toward the right when possible.

Coefficients should be distributed in such a way as to make the rule as short as possible.

Graduations should not be too close, and all unnecessary points omitted.

The exact values, such as 0.1, 2, 5, 150 should be used in graduating the axis in order to relieve the operator, of locating the decimal point in the result.

Logarithmic axes may be copied from a standard slide rule, direct, or with proportional dividers.

The length of the slide should be greater than the length of the frame.

Getting the Greatest Return From Plant Investment

Industrial Buildings Must Be Designed Solely for Their Effect upon Quantity, Speed and Cost of Production

By Hugh M. Wharton

Every dollar spent today in industrial construction must yield a maximum of return. So the complete scheme of manufacture should be determined upon before building plans are started. This calls for the closest coöperation between the architect or mill engineer and the production superintendent.

Mr. Hugh M. Wharton *was for five years production superintendent, and later works engineer of the Westinghouse Electric and Manufacturing Company. Afterward he was assistant general superintendent, Allis-Chalmers Company, and mechanical superintendent, Bird & Son. During the post few years he has been in consulting practice engaged in making plans for industrial plants.* Mr. Wharton *designed the new rifle-making works of the Remington Arms Union Metallic Cartridge Company, built during 1915 and 1916.*

WITH the present scarcity of labor and the prevailing high prices of materials the cost of whatever new industrial construction has to be undertaken under these conditions is bound to be abnormally high and, for that reason, it is all the more necessary to make every effort to hold the investment down to a minimum and to secure the greatest possible return for the money invested. A great deal could be achieved toward increasing the return from the investment if those who contemplate the erection of buildings for manufacturing purposes would recognize fully the importance of treating the design of such buildings as a problem in production rather than as one in architecture or structural engineering.

The primary object of any manufacturing business is to make money for the owners by turning out the greatest possible quantity of product at the lowest possible cost; hence each item of the equipment should be regarded merely as an instrument to be used in accomplishing that purpose and should be designed or selected solely with that object in view. As the buildings of an industrial plant are simply an important part of the equipment for production they should be designed, like the rest of the equipment, to suit the needs of the manufacturing operations that are to be performed. In other words, the creation of the plant should be treated as a step in the preparation for manufacture and not as a building job; and all architectural and structural details should be considered only for their effect upon speed, quantity, or cost of production after the completed plant is in operation.

Although this is by no means a new idea, yet, in so many instances, the subject is apparently given such scant consideration from this point of view that it would seem to be well worth while to bring it to the attention of industrial managers and engineers at this time when all our industries are striving to reach their maximum efficiency of production.

Necessity of Manufacturing Experience

Everyone engaged in preparing plans for industrial works will, of course, agree that this is the correct point of view and every designer, no doubt, honestly believes that, in preparing his plans, he gives proper consideration to the productive operations that are to be performed; but, as a matter of fact, a great many plans are drawn by men who have been trained only in building construction, or in building design, and who have never had any real opportunity to acquire experience in manufacture. From the very nature of their training it is almost certain that they will fail to appreciate many of the important requirements of production. There is a vast difference between ordinary superficial recognition and a really intimate knowledge of the processes of manufacture and no one who has not been actively engaged in planning and following these processes can possibly have the intimate knowledge needed to predetermine, with any reasonable degree of accuracy, the ultimate effect upon production of any proposed plan or detail of construction.

Before even preliminary plans can be drawn the designer ought to know definitely what operations are to be performed, what machines and other equipment are to be used, how these machines are to be arranged in the different departments, and the sequence of operations. Certainly this information can be given accurately by no one but an expert in production, and, if the completed plant is to fulfill the purpose for which it is intended, the whole plan of manufacture should be fully developed *before* the building plans are drawn. In too many instances this order is reversed, and, although a rough general plan of manufacture is often prepared in advance, the details are not fully developed beforehand and the arrangement of the equipment is planned after the buildings are started, or even after they are finished. It is then too late to do anything more than to fit the arrangement of the equipment to the buildings. Surely no argument is needed to show that the desired result cannot be obtained by following this latter method.

Construction Must Be Adapted to the Manufacturing Operations.

The type of construction to be adopted for the buildings should also be determined entirely by the nature of the manufacturing operations to be performed, that is, by the machinery and other equipment to be housed and the kind of material to be handled. Certain types of construction are well established as standard for certain classes of manufacture but for a great many others there are no such standards and we find similar manufacturing operations housed in all sorts of structures. The problem in these latter cases is to select the type of construction that combines the least number of disadvantages with the greatest number of advantages *for production*, that is, to select that type of construction in which production will be a maximum in speed and quantity and a minimum in cost.

Lowest Cost of Products Must Be Sought

The solution of this problem is never easy, and is often very difficult, as the result sought is the lowest cost of the manufactured product and not necessarily the lowest cost of construction of the plant, for that is only one item in the total cost of the product. The size, shape, and width of buildings, height between floors, spacing of columns, arrangement of floor beams, number and location of stairways and elevators, provision for light and ventilation, and even the material used in the construction of the buildings all affect in some way either the arrangement of machine tools, the handling and transportation of materials, the cost of erecting and moving machinery, the cost of maintenance of the plant, or the convenience of the operatives. Some of these effects are not always apparent, but they should always be determined for the reason that any unnecessary burden imposed in this way upon production, however slight in itself, may be multipled indefinitely during the life of the plant. Even in the case of construction that is expected to be more or less temporary, the planning should be done in the same way and with just as much care as if the work were intended to be permanent. There is no good reason for imposing even a temporary burden that is unnecessary and that can easily be avoided.

Treating the planning of industrial construction as a problem in production does *not* mean the elimination of the architect or mill engineer. It simply means the complete development of the whole plan of manufacture *before* building plans are started and afterward the closest possible coöperation between the architect and the production force during the preparation of these plans in order to insure their absolute harmony, in every detail, with the approved plan of manufacture.

Putting It Up to the President

By Lester Bernstein

Supervisor of Traffic Statistics,

Baltimore and Ohio Railroad Company

THE president of a corporation holds his position because among other things of his ability to reach proper conclusions quickly and make correct decisions.

An executive is a busy man and his responsibilities are many. To the stockholder it is the president's fault if dividends are not earned and business does not continuously expand, profits do not always pile up higher and higher, taxes increase, the legislatures pass punitive laws and what not. To the employees it is the president's fault if they have to come to work on time, do not have their wages raised every so often, have to work honestly, cannot get off to go to the baseball games and what not. To the public it is the president's malevolent fault if prices go up, if a clerk misdirects a shipment, if a clerk forgets to say thank you, if an error is made in billing, if he is out when someone calls to see him, and what not. Everybody holds the president responsible for everything down to the smallest detail.

While the president may have come up the line from the humblest position, it is not possible that he has held every position in the corporation's service, yet he is supposed to know everything about every position and every department. He must needs be well informed. He mostly keeps himself informed by regular routine reports, helped out by inspection trips through the different offices and parts of the property. Routine reports and even inspections do not always give the information his searching mind craves. To supplement the information regularly coming to hand he avails himself of special reports which may be on any subject for which he has need.

Faults of Reports

Most reports on special subjects suffer the dire faults that they are not concisely written and too frequently poorly gotten up, in many instances require too much time to find any particular thing in them and when found the impression conveyed is both vague and poorly defined.

Because an executive is an extremely busy individual and does not have all day to puzzle out and then finally guess at what the real meat in a report is, such reports should be: brief, concise, properly arranged.

Telegraph blanks, excepting those of commercial telegraph companies, usually have somewhere printed on them two little words, "Be Brief." For the investigator and report-writer "be brief" is a good motto. Being brief does not mean leaving out conjunctions, prepositions, articles or other vital grammatical parts. A report need not be written in Emersonian English, though it should have some literary merit. Always the better the grammar the clearer is the reading and more readily can the text be followed. Being brief does not mean leaving out of the report any pertinent matter which really ought to be included. Being brief means the expressing of thoughts with the fewest necessary words. Usually, a thing is best said when it is said in the fewest words. Without clear thinking, concise expression is difficult. The best helps to expressing exactly what you think are eliminating the always confusing irrelevant, and making words efficiently do their duty—using the fewest necessary words.

The thousands of words in any modern language are there because each one has a meaning peculiarly its own. To be concise requires a vocabulary. A good way to acquire a vocabulary is to continually seek one word to do the work of two. Revise, revise and revise some more! Many good thoughts have been lost to humanity because the ability to properly express them was lacking. Many a light has failed to shine because of an inability to make its real worth appreciated.

An Example In Point

The example following, before and after being edited, is from a report on an interurban railway by a gentleman, well schooled at that, who knew his subject and was right at home in his work; the writing of the report caused him almost nervous prostration, disgust, and keen dissatisfaction because he could not write what he had in his mind. It is little wonder that too many executives are "report shy."

"Because of congestion trains are operated in three or four sections, each of a motor and two or three trailers to secure the utilization of full car supply" . . . "Due to heavy travel trains are operated in three or four sections, each of a motor and two or three trailers to secure the best utilization of the equipment."

The value of many reports can be markedly enhanced by the better arrangement of the matter in them. Before discussing this point, a few traits of the executive mind may not be amiss, because they have to be reckoned with.

Traits of the Executive Mind

The executive mind in its attitude toward a report submitted to it, in its impatience is almost effeminate and in its directness is quite youthful. The proverbial female of the humorous periodicals when reading a book turns to the last chapter or the last page first to see how it ends. Remember the little boy at school who when given a problem in arithmetic to solve, at once turns to the back of the book to see the answer to lessen the agonies when working the solution. Another trait of the executive mind, again betokening the fact that it has not lost the vigor of youth, is the never ending number of questions asked, and the unending number of things asked about. Some of the questions asked require time to formulate their reply.

The executive mind has many things to dwell upon and, when information called for is not instantly forthcoming, it does not stop and wait but surges right on with something else to be accomplished. Because a number of reports may possibly be in preparation at the same time, had an executive two tongues to talk twice at once, every time he espied his secretary bringing him a report, he would simultaneously ask, "What is it about?" and "What points does it make?" And when he saw that a report was several hundred or more pages long, well might his soul quail, and he wish every report-writer were where a fuel dictator would be out-of-order.

Purposes of a Report

A report may be requested by an executive for one of many reasons, none of which he is obliged to divulge. The reasons may range from, to inform him about something of which he knows nothing, to better informing him about something on which his ideas are not too clear or definite, or to verify his already well defined ideas.

An executive is not required to state the ultimate purpose of a report. He may want it for the basis of immediate action or for guidance to something in the future. He may simply want it purely for his own information.

In life, time is a vital element. Doing more things in a given length of time is equivalent to living more in that time. It takes time to recall, to think, and to arrive at a conclusion. What happens in the cerebrum in the process of recalling or thinking is of course a matter of conjecture. Nevertheless time, even if extremely short, is required for the mental processes.

The only reason which should determine the length of a report should be that everything in it is pertinent to the subject discussed. A report can be of any length, though there is no reason why an executive should be compelled to read all of it unless he so desires.

Because an executive wants to know the meat of a report as soon as he can, there is no reason why he should be compelled to waste time hunting for what he wants or to laboriously thumb pages to find out the basis for something in the back of the report. Time to him is precious, therefore project the essentials just as quickly as possible in the beginning of the report.

Arrangement of a Report

A properly arranged report when delivered to an executive must take all the points enumerated into consideration and should show in the order given the following arrangement: Title page, foreword, contents, recommendations, conclusions, summary, body.

The order in writing a report is usually in the reverse of that just given. First the body of the report is worked up, then it is summarized, then the conclusions are written, then the recommendations, then the contents, then the foreword and finally the title page.

The title page should in as few words as possible accurately give the subject of the report. The arrangement of the title should be studied to make its most pertinent part stand out most prominently.

The foreword should briefly state the subject matter contained in the report and usually can be kept as short as one hundred words. Few forewords really ought exceed five hundred words.

The purpose of a title page, more important than giving the file clerk his clue for filing, should be to supply the stimulus for mentally grasping what the report contains.

The foreword should complete the mental processes started by the title page. In other words should permit the mind to definitely get settled for concentration.

A table of contents, though probably few of them are ever perused with the first reading, should show the different details and phases covered in the report. Its perusal helps the mind to form some idea of the discussion following because the more angles from which a subject is viewed the more likely is the report to be of value.

As a general rule it is well not to include recommendations in a report unless specifically asked for. Recommendations should be decided and positive. There never should be any alternative recommendations because alternative recommendations plainly show a weakness in the report. When the scope of a report has been limited by instructions, recommendations are likely to be in error, though they may be of value to the executive because of a new viewpoint possibly presented.

The conclusions ought to be as brief as possible and contain nothing but the convictions arrived at from what follows.

The summary should contain nothing but the substance of the body of the report. The main arguments should be brief. The lesser points and minor details in the body of the report may be entirely omitted.

The Minimum of Reading

In the reading of a report as here set forth, the executive has an opportunity to get the salient points out of it in a minimum of time. His procedure in the reading might be something like the following:

Should he not agree with the recommendations, wholly or in part, he would then read the conclusions to determine on what grounds the recommendations were based. The reading of the conclusions may show him that his previous conceptions were not correct; and if he accepts the conclusions as given, there is then no need for his reading further.

In the formulation of the body of the reports facts and information pertaining to the different phases should as far as possible, be kept together. The ideal arrangement is of course, to have each phase, subject, or item on a separate page. Each such page should have a heading, which heading ought to appear in the table of contents.

Details of Preparation

While many employees of a corporation may think their executives are crabs, they must remember that in so thinking they are nature faking; for when a crab loses its eyes it grows new ones, but when an executive loses his eyes he cannot grow new ones. Therefore, to make easy reading, double spacing should be observed in typewriting. Paper may be expensive but five minutes of the time of an executive of a large corporation will buy a lot of stationery.

A generous space should be left on the right of each page for marginal notes. A blank fly page in the front of the report and one or more in the back of the report are of value not only for giving a finished appearance, but for additional space on which the executive may record notes, comments, or queries about what he reads. Because most reports are not overly lengthy, an index in most cases is not needed. Where a report is to be used as a reference work, an index is not inappropriate and should be placed in the back of the report following the body.

Cost of Industrial Health Supervision

Records from 47 Metal-working Plants, 300,000 Employees and 2,000,000 Cases Give an Average Cost per Case of 27 Cents.

By Reginald Trautschold

Executives are anxious to know what it costs to maintain the health of their employees, for they recognize that all illness in industry is a waste most of which can be prevented. This article is one of the first ever printed giving actual cost figures of health supervision. Statistics have been drawn from 16 industries, 99 plants, nearly 500,000 employees and over 2,000,000 cases. The average cost per case ranges from 27 cents to $2.89, depending upon the industry; metal working shops have the lowest average.

Mr. Reginald Trautschold *was educated at Cornell University, and has specialized in power-plant design, machine design and factory economics. From 1898 to 1911 he held positions of designer, superintendent of construction, chief engineer and sales manager with several well-known manufacturing firms including The Sprague Electric Company, Marine Engine and Machine Company, Henry R Worthington, Arnold Sewing Machine Company, Robins Conveying Belt Company and the Intercontinental Engineering Company. Since 1911 he has practiced as a consulting engineer specializing in hydro-electric development and the economics of material handling and power production.* Mr. Trautschold *has been a frequent contributor to the technical press and is already well known to many of our readers.*

INDUSTRIALLY speaking, all illness represents waste and like all other waste must be as far as possible eliminated. Health is the backbone of labor maintenance, without due regard for which no lasting benefit can be realized by the industry, the community or the nation. The proper guarding of machinery, light, well ventilated factories, as pleasant and comfortable surroundings as the activity and locality of the industry will permit, shortened hours of work, etc., are all recognized mediums (requirements in many states) whereby the health of our industrial workers is improved with highly gratifying results in efficiency, skill and contentment of the workers and in nine cases out of every ten—if not in every case—with material reduction in production costs and improvement in product. To maintain good health and to raise the standard of health is now generally admitted to be economic *wisdom*, but to guard against accidents and to wage unrelenting war against the elusive germ of sickness which can so seriously counteract the gain resulting from the physical improvements, supervision of health (medical and surgical) is an economic *necessity*. It is one of the most important of considerations and has been taken up seriously by hundreds of establishments, employing hundreds of thousands of workers, and must unquestionably be taken up by numberless other employers.

There are few industrial establishments of today which would not be willing to consider a regular system of health supervision if they could be assured that such precautionary measures could be undertaken for quite a nominal outlay, and an outlay which could not fail to return very handsome dividends on the investment. Entirely aside from all ethical, moral, humanitarian or philanthropic considerations, a regular system of health supervision or employees is good business for any establishment, be it large or small. It requires no great amount of argument to convince the average employer that each day that one of his workers is prevented from reporting for work, due to accident or to illness, and every day that any members of his force are not feeling fit for his or her task, represents to him a direct monetary loss. A loss which is not measured in a few cents simply, or even in terms of a dollar or two, but in considerably larger figures, for each day of absence on the part of a worker entails for the employer a loss considerably greater than the wages.

MAINTAINING LABOR INCREASES OUTPUT

A claim that the efficiency of a worker whose health is properly supervised—minor ailments and slight injuries given immediate attention—is greater than that of a worker not afforded such assistance, that the average output of the "cared for" employee is increased by at least one and two-fifths per cent. is so very conservative as to prohibit any controversy or argument and it remains but to present irrefutable figures on costs of health supervision in industry to convince the most skeptical that proper health supervision is neither costly nor philanthropic, but a sane business proposition which will pay large and assured returns.

In October, 1916, the National Industrial Conference Board issued a report, for the Conference Board of Physicians in Industrial Practice, incorporating data submitted by forty-one industrial plants employing some 223,416 workers. The facts presented were culled from a diverse variety of industries and gave the average annual cost of health supervision per employee per year as $1.88. The lowest average cost reported, at that time, was in the metal trades plant employing but 385 persons, where the average annual cost of health supervision was but 53 cents per employee; the highest, in a paint factory employing 2,448 hands, where the cost was $7.79 per year. Health supervision was at that time still such an innovation that some of the reports were but approximations based on more or less incomplete records or on too short an experience to be truly typical. Mr. Magnus W. Alexander, Managing Director of the National Industrial Conference Board, has more recently, August, 1917, compiled for the same medical board a much more exact and comprehensive report on the cost of health supervision in ninety-nine industrial establishments, employing an aggregate of close to half a million workers.

LOSSES FROM SLIGHT AILMENTS

Furthermore, the interruptions to efficient activity on the part of the force are relatively more serious in the case of slight indispositions which may cause the loss of an occasional hour or two, or an infrequent day, for which obviously it would be quite out of the question to provide and train a substitute, than from the more serious cases which prevent the worker from reporting the work for some time and make it imperative that the employer engage another worker to go on with the interrupted work.

A sugar coated pill, an antiseptic bandage properly adjusted, a little disinfectant, or some equally simple precautionary measure may have a much more powerful influence in keeping up production than the installation of some new type of equipment.

The healthy worker is far less liable to meet with a serious accident—one for which the law stipulates that the employer is responsible and must pay, and that liberally—than one with a headache or a clumsily bound up finger, and the healthy worker is usually the contented worker, the one who can turn out the greatest amount and highest quality of work.

What Is Included in Health Supervision?

A sum equivalent to the wages of the average worker for but one-half a minute each working hour of the year would be more than sufficient to cover the total average medical and surgical cost (the entire cost of health supervision) per year per employee in an establishment suffering from aggravated ill health and unusually frequent accidents, while the wages of the average worker for but ten seconds per working hour a year would more than cover the usual cost of proper health supervision. The entire cost of health supervision includes the salaries of physicians and nurses, cost of any outside medical or surgical service which might be required and the cost of all medical and surgical supplies; it excludes, however, all compensation for injuries, wages paid employees while off duty and over head expenses, as such expenses, should they arise in an establishment making proper provision for the health supervision of their employees, would be borne by the insurance companies as part of the insurance contract, which—by the way—would command a much lower premium in an establishment providing proper attention to the health of employees than in one in which the employer attempts to shift his responsibilities to the shoulders of the insurance company.

TABLE 1

SUMMARY OF MEDICAL AND SURGICAL CASES

Industry	Number of Establishments	Number of Employees	Cases Treated Medical and Surgical	Total Cost
Metal trades	47	294,646	1,988,991	$541,771
Rolling mills (brass)	7	49,317	358,574	137,047
Light and power	7	24,921	49,046	92,601
Chemicals	6*	10,572	78,744	34,797
Transportation	5	35,795	81,591	69,633
Food	5	13,650	69,565	39,875
Rubber	5	27,462	234,069	76,089
Textiles	4	8,939	67,380	24,177
Paint	2	4,023	10,255	29,635
Leather	2	3,026	9,440	6,102
Publishing	2	3,358	6,742	3,473
Smelting and refining	1	1,270	2,832	6,932
Coal mining	1	2,454	2,842	4,637
Coal and iron mining	1*	11,000	131,898	130,000
Gold mining	1*	2,500	62,126	35,590
Miscellaneous	3	2,611	11,019	6,126
	99	495,544	3,165,114	$1,238,485

*Includes establishment at which treatment is extended to the families of employees at their home.

Maintaining Labor Increases Output

A claim that the efficiency of a worker whose health is properly supervised—minor ailments and slight injuries given immediate attention—is greater than that of a worker not afforded such assistance, that the average output of the "cared for" employee is increased by at least one and two-fifths per cent. is so very conservative as to prohibit any controversy or argument and it remains but to present irrefutable figures on costs of health supervision in industry to convince the most skeptical that proper health supervision is neither costly nor philanthropic, but a sane business proposition which will pay large and assured returns.

In October, 1916, the National Industrial Conference Board issued a report, for The Conference Board of Physicians in Industrial Practice, incorporating data submitted by forty-one industrial plants employing some 223,416 workers. The facts presented were culled from a diverse variety of industries and gave the average annual cost of health supervision per employee per year as $1.88. The lowest average cost reported, at that time, was in the metal trades plant employing but 385 persons, where the average annual cost of health supervision was but 53 cents per employee; the highest, in a paint factory employing 2,448 hands, where the cost was $7.79 per year. Health supervision was at that time still such an innovation that some of the reports were but approximations based on more or less incomplete records or on too short an experience to be truly typical. Mr. Magnus W. Alexander, Managing Director of the National Industrial Conference Board, has more recently, August, 1917, compiled for the same medical board a much more exact and comprehensive report on the cost of health supervision in ninety-nine industrial establishments, employing an aggregate of close to half a million workers.

The general total average annual cost of proper health supervision, as given in this latter report, is $2.50 per employee, but this is not truly representative, for in four plants medical and surgical attention had been extended to include the families of employees, naturally adding considerably to the cost of supervising the health of the employees. Omitting these four plants, the annual average cost per employee is reduced to $2.21

Tables 1, 2 and 3 give concise summaries of the findings of the investigations as reported, arranged in various orders for convenience in ready comparison. Table 1 lists the data into general classes of industry, arranged in order of *number* of establishments represented; Table 2, the classes of industry arranged in order of healthfulness, as indicated by the average number of cases treated per employee during the year, and Table 3, the classes arranged in the order of danger or degree of hazard, as indicated by the average cost per case.

No logical claim can be advanced that these listings as to comparative healthfulness, degree of hazard of the respective industries, are really typical of the industries, but rather that the listing are convenient as reference and are, to a certain extent, indicative of what proper health supervision has done toward improving conditions. It is ridiculous, for instance, to accept coal mining as the most healthful industry and gold mining as the least healthful, particularly when iron mining in combination with producing coal would rank but slightly above gold mining; or to accept work in metal trades plants as the safest and work in paint factories as the most dangerous of industrial vocations. Neither can averages be taken as typical without considerable further investigation, for, in nearly every class of industry in which data for a number of establishments were reported there are wide variations between the high, average and low records, as amplified in Table 2. The reports are so comprehensive, however, and cover such broad fields with utter impartiality as to results that there can be no question but that the report gives far more than simply general indications and that investigations into the kernel will bring to light much valuable and useful information.

TABLE 2

Costs of Health Supervision

Industry	Cases per Employee			Costs per Employee			Costs per Case		
	High	Average	Low	High	Average	Low	High	Average	Low
Coal Mining	$ 1.16	....	$ 1.16	$ 1.89	....	$ 1.89	$ 1.63	....	$ 1.63
Light and power	3.96	$ 1.97	.13	6.05	$ 3.72	1.90	21.48	$ 1.89	.95
Publishing	2.36	2 01	1 98	1.06	1.03	.40	.53	.52	.17
Smelting and refining	2 23	...	2.23	5.46	....	5.46	2.44	....	2.44
Transportation	3.33	2.28	.94	2.95	1.95	1.15	1.34	.85	.70
Paint	5.28	2.55	1.36	7.90	7.37	7.13	5.26	2.89	1.50
Leather	4.16	3.12	1.33	3.15	2.02	1.35	2.36	.65	.32
Food	18.65	5.10	1.06	4.50	2.92	1.89	3.15	.57	.24
Metal trades	18.03	6.75	1.09	7.40	1.84	.53	8.84	.27	.10
Rolling mills (brass)	18.40	7.28	3.61	4.39	2.78	2.08	.61	.38	.19
Chemicals	22.00	7.45	3.64	6.46*	3.29*	2.53	1.36	.44*	.21
Textiles	18.00	7.53	3.59	3.89*	2.70*	1.56	.75	.36*	.22
Rubber	13.72	8.52	2.70	3.98	2.77	.96	.42	.32	.23
Coal and iron mining	12.00	....	12.00	11.82*	....	11.82*	.99*	....	99*
Gold mining	24.80	....	24.80	14.24*	....	14.24*	.57*	....	.57*
Miscellaneous	5.59	4.22	3.44	1.47	2.35	2.70	.70	.56	.43
General Averages		$6.40			$2.50*			$0.816*	

*Includes establishments at which treatment is extended to the families of employees at their home.

TABLE 3

Average Costs of Health Supervision

Industry	Number of Employees	Average Number of Cases per Employee	Average Cost per Case
Metal trades	294,646	6.75	$0.27
Rubber	27,462	8.52	.32
Textiles	8,939	7.53	.36
Rolling mills (brass)	49,317	7.28	.38
Chemicals	10,572	7.45*	.44*
Publishing	3,358	1.03	.52
Gold mining	2,500	24.80*	.57*
Food	13,650	5.10	.57
Leather	3,026	3.12	.65
Transportation	35,795	2.28	.85
Coal and iron mining	11,000	12.00*	.99*
Coal mining	2,454	1.16	1.63
Light and Power	24,921	1.97	1.89
Smelting and refining	1,270	2.23	2.44
Paint	4,023	2.55	2.89

*Includes establishments at which treatment is extended to the families of employees at their home.

The metal trades are the most thoroughly covered in the report, data from forty-seven establishments, employing a total of close to three hundred thousand hands, for which approximately two million cases (medical and surgical) were treated are presented, an analytical investigation into which will unquestionably indicate the most truly typical deductions to be gleaned from the report—deductions which will indicate the reliance to be placed on the averages for the industries less comprehensively represented. It is true that the average annual cost of health supervision, as reported for the metal trades is somewhat below the average, but the variations in cost reported ($7.40 high, $1.84 average and $0.53 low, per employee, per year) are wider than in the majority of other industries, and, though in the arbitrary classification of the industries, the metal trades rank as the least hazardous, they are also well below the average in healthfulness, gaged by the number of cases (surgical and medical) per employee per year.

Of the forty-seven metal trade plans, that employing the smallest number of workers carried on its payroll an average of 400, while the largest maintained a working force of some 37,107. The balance of the plants employed working staffs between these two limits. For convenient classifications as to size, the smallest plant may be designated as No. 1, the next in number of employees No. 2, and so forth, the largest plant, that employing thirty-seven odd thousand, being No. 47. These designation numbers bear no direct relation to the number of hands employed, but simply indicate the respective sizes of the establishments, in point of employees. The maximum number of cases (medical and surgical) per employee treated in any one plant was slightly over eighteen, and occurred in a plant of comparatively small size, one employing but 776 men, while next to the minimum number of cases treated, about four cases to ten employees, occurred in a plant employing even fewer hands, 720. The general average shows twenty-seven cases for each four employees per year—6¾ cases per worker.

The average number of cases per employee in each of the forty-seven establishments is graphically depicted on Chart I, in diminishing order, i. e., the plant with most cases ranked first. This graphic portrayal forcibly brings out the fact that the size of the plant has little or no controlling influence upon the number of cases, for, of the five plants unfortunate enough to have the greatest number of cases per employee, one was a small plant, two were establishments employing a comparatively large number of workers and the other two plants of medium size. Similarly, the five plants which escaped with the fewest number of cases include two small plants, two of medium size and one which might be classified as either small or medium sized. Another fact brought out by the graph is that approximately 70 per cent. of the establishments treated, fewer cases than the average and that fully half of these, about 35 per cent. of the total number of establishments, handled less than half the average number of cases, the most fortunate plant, one of medium size, having occasion to treat but nine cases per hundred employees. Only about 30 per cent. of the establishments were called upon to care for more than the average number of cases per employee and the greater number of this minority were establishments employing an average number of workers, plants of medium size, intermingled with which are about equal numbers of comparatively large and small establishments.

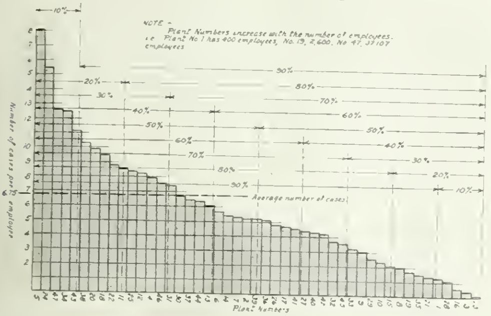


CHART I. CASES PER EMPLOYEE (SURGICAL AND MEDICAL) TREATED
47 Metal Working Industries

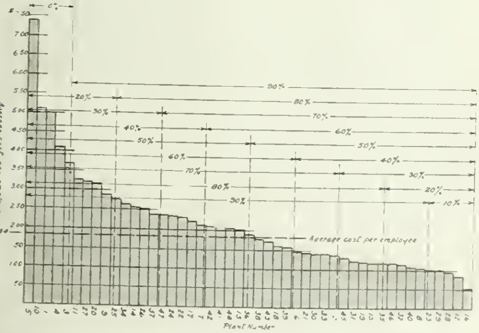


CHART II. AVERAGE COST (SURGICAL AND MEDICAL) PER EMPLOYEE
47 Metal Working Industries

Accepting the average number of cases (medical and surgical) in the metal trades as typical of that industry is well within legitimate bounds and quite conservative, for seven plants out of ten would show more favorable results and fully as many establishments as were burdened with more than the average number of cases per employee would escape with less than half the average number. If the establishments with unusually many and unusually few cases are taken as exceptional and disregarding in estimating the probabilities of cases, the mean annual average in the metal trades would be in the neighborhood of five cases per employee. However, counting on the probability of 6¾ cases for metal trades establishments should make any disappointment in the results obtained in a plant providing proper health supervision very unlikely. This number of cases would include all minor ailments, cuts and bruises, etc., which would naturally be attended to where proper facilities are provided and otherwise ignored and neglected.

The number of cases to be anticipated in a plant, though it emphasizes the necessity of proper health supervision in industry, forms no conclusive argument to the employer who imagines he cannot afford to look after the health of his workers, unless this information is accompanied by pretty reliable data as to the probable cost to him of rendering the much needed relief. Charts II and III depict the average cost of treating the cases in the same forty-seven metal working establishments, arranged in order of costliness—the most costly ranked first, etc.

The variations in cost, shown in Chart II, average cost per employee, though quite marked, are not as pronounced as the variations in the number of cases per employee, depicted on Chart I. Furthermore, with the exception of plant No. 5, the most costly in health supervision per employee and also the one in which most cases per employee were treated, there is scarcely an establishment which ranks in the same order in "cost per employee' as in "cases per employee," though the plants at which the number of cases per employee were close to the average are pretty uniform in cost. The exception in the case of plant No. 5 indicates beyond question of doubt that the conditions in that particular establishment are quite unusual, and this plant could legitimately be ignored in compiling averages for numbers and costs of cases. If this were done, a material reduction would show both in the average number of cases and in the cost of the cases. Though the graph, Chart II, indicates that about half the costs for health supervision were below and half above the average of $1.84 per employee per year, the fact that plant No. 5 is included in the compilation of the average makes such average about as conservative for cost as that of 6¾ cases per employee is for number of cases. Accepting the figure of $1.84 as the average cost per employee for proper health supervision during an average year of 2,500 working hours, the average cost of health supervision for each hour's work of an employee amounts to less than three-quarters of a mill. Each second of a worker's time earning thirty cents an hour —a rate which may be taken as representing the average wage of a worker in the metal trades—would be worth something more than eight-hundredths of a mill. Therefore ten seconds of a worker's time would command close to 15 per cent. more than the cost of an hour's proper supervision of his or her health. Even in the case of plant No. 5, at which occurred an unusual number of cases, costing very much above the average. $7.40 per employee per year, the average cost of health supervision represents less than the value of thirty-one seconds of each hour of a thirty cent per hour worker. Authentic figures thus show that the prevention of the usual winter colds—prevention of which is quite possible by proper medical attention—such colds necessitating, if nothing more, frequent interruptions for the worker to blow his nose, or the removal of the excuse for complaining of a headache brought about by eye strain, indigestion or almost any other of the minor ailments to which we are all subject and have not the fortitude to completely ignore—just the prevention of these little items would represent a saving sufficient to go a long way toward paying for proper health supervision of our industrial workers.

Chart III which depicts the average costs per case treated in the forty-seven metal trade establishments brings out some interesting points that should tend to remove any lingering doubts as to the expensiveness of industrial health supervision. By far the most costly average per case occurred in plant No. 3, which, as was shown on Chart I, had next to the fewest number of cases. Chart II shows that the cost *per employee per year* was considerably above the average, it is true, but only about half that of the cost per employee in plant No. 5, where the cost per case was but forty-one cents. Of the thirty-four plants in which the average cost per case is above the average of *27.2* cents, all but five treated below the average number of cases per employee. This forcibly confirms the law of averages and indicates that in establishments where the cost per average case in high there are usually serious accidents requiring surgical attention, that the general health of the employees is good and that the minor accidents so prevalent where health is poor are few in number.

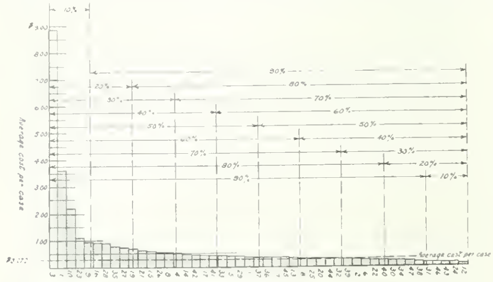


CHART III. AVERAGE COST PER CASE (SURGICAL AND MEDICAL) TREATED
47 Metal Working Industries

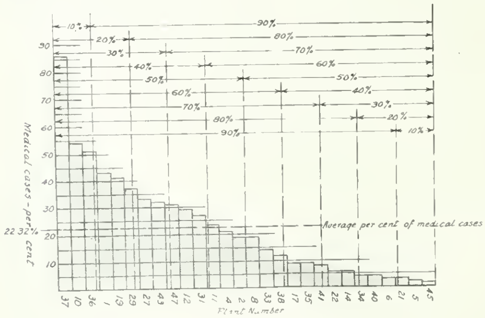


CHART IV. PROPORTION OF MEDICAL CASES TREATED
28 Metal Working Industries

In twenty-eight of the metal trade establishments care was taken to segregate medical from surgical cases and the proportions of medical cases throws considerably more light upon the value of proper health supervision. There is probably not an industrial manager in the country who does not dread accidents to his employees, be the accidents serious or minor, for such cases, which nearly invariably necessitate and monopolize surgical attention, are those which he has to pay for, directly, or indirectly through insurance companies —the law demands it. Medical cases, on the other hand, although this is not fully appreciated by many employers, have to be directly paid for by the management, as, unless serious, they can seldom be relegated to the insurance companies for adjustment. The employer may pay for the medical cases indirectly and unknowingly, but pay for them he must, for they reduce the efficiency of his employees, reduce his output and elevate his production costs.

Chart IV shows the percentages of the number of medical cases treated in the twenty-eight metal trade establishments referred to. The average per cent. of medical cases is between one-fifth and one-quarter of all cases treated and the fluctuations in the percentages of the various plants is quite marked, about 40 per cent. being above the average. These higher percentages are particularly illuminating, for they explain in great measure the reasons for some of the higher annual health supervision costs shown on Chart II. Take the four largest percentages on Chart IV, to illustrate. These all occurred in establishments at which the cost per employee was above the average, yet, in each instance, the number of cases per employee was below the average (see Charts I and II). This means that the average medical case entails a greater expense for treatment than the average surgical case.

The cases which the employer has usually to pay for without assistance from the insurance companies, and which, it must be admitted, could be most readily prevented by proper medical supervision, are really the more costly ones. Added to this, it is the medical case which more seriously interferes with a worker's industry. They are apt not to respond as rapidly to treatment as the average surgical case which has been properly dressed and are much more liable to sap the energy of the worker. It is far easier to attend to a task with a carefully bandaged finger or arm than it is with an obstinate headache. Though medical cases are not apt to be as frequent in an establishment which takes proper precautionary measures to maintain the health of its employees as cases requiring some kind of surgical attention, it would probably pay and pay well to install facilities for caring for medical cases even if surgical cases were neglected. Medical cases drain the vitality of the worker, seriously interfere with his efficiency and are paid for at a maximum price by the employer who does not provide every facility for their treatment.

Charts V and VI indicate the seriousness of surgical cases in those of the metal trade establishments in which surgical case expenses were most carefully compiled and classified—Chart V showing the number of redressings required per average case and Chart VI the home visits required for the proper attention to the patient in the more serious cases. Naturally redressings and home visits, as they are counted as cases in the compilations, tend to multiply the number of cases treated per employee and also to reduce somewhat the cost per average case, though the seriousness of an accident may at times elevate the average cost of health supervision per employee. This is particularly noticeable in the instance of plant No. 22, at which an average of 8.4 redressings for each surgical case was necesasry. Chart III shows that the frequent surgical redressings at this establishment did not bring the cost per case materially below the average; Chart I, that even with the numerous redressings the number of cases per employee were not very much greater than the average; and Chart II shows that the average cost of health supervision per employee was some 16 or 17 per cent. higher than the average. Similar inspections of the various charted records for plants in which unusually frequent redressings were necessary reduce, as a rule, the cost of health supervision per employee, provided, of course, medical cases are not unusually frequent.

The graph, Chart VI, though apparently contradictory in certain respects to that of Chart V, actually emphasizes the value of proper facilities at the plant for caring for surgical cases. It would naturally be expected that the more serious accidents would require the greater number of redressings, yet it will be noted from Chart VI that in some establishments at which the number of redressings was high comparatively few home visits were made, while at other establishments where redressings per surgical case were less frequent much more frequent home visits seem to have been necessary. This apparent contradiction is explained by the fact that a worker who has met with certain kinds of accidents requiring surgical attention will recuperate much more rapidly when his general health is supervised than when in a run down condition. This frequently permits the healthy convalescent to report at the plant for redressings and at the same time attend to some of his regular duties. Of course, this cannot be advanced as a rule, but the various charts indicate that this is not unusual.

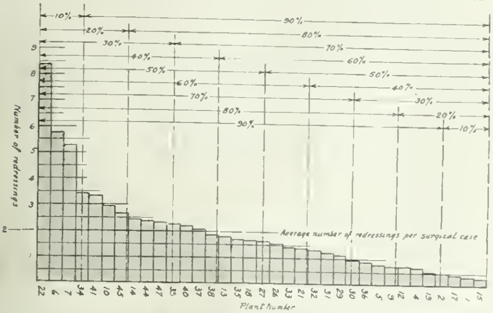


CHART V. AVERAGE NUMBER OF REDRESSINGS PER SURGICAL CASE
35 Metal Working Industries

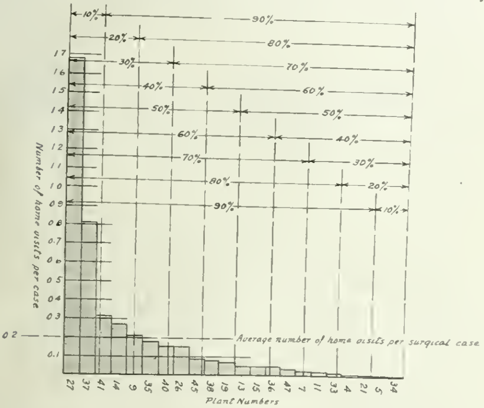


CHART VI. AVERAGE NUMBER OF HOME VISITS PER SURGICAL CASE TREATED
22 Metal Working Industries

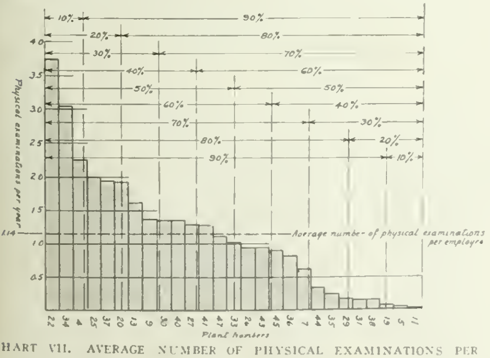


CHART VII. AVERAGE NUMBER OF PHYSICAL EXAMINATIONS PER YEAR PER EMPLOYEE
27 Metal Working Industries

As a general average, a case requiring surgical attention will necessitate two redressings and one surgical case out of every five will require attention at the home of the patient. These estimates are obviously subject to wide variations, but they are quite accurate enough to serve as bases upon which to plan for an adequate medical force for the usual run of mishaps which must be expected and anticipated in almost any metal-trade establishment.

There is one other important matter pertaining to health supervision in industry that deserves attention, the value of physical examinations of the employees. As a precautionary measure there can be no question but that physical examinations, which naturally can be performed at a minimum of expense in establishments maintaining facilities for proper health supervision, are extremely valuable—epidemics can be forestalled, contagion prevented, etc.—but their value to the employer in dollars and cents is not generally recognized. In nineteen of the forty-seven metal trade establishments, physical examinations were made with more or less frequency, as graphically depicted on Chart VII, and in scarcely an instance were the medical cases treated in the particular plants above the average of 22.32 per cent. of the total number of cases and in many instances considerably below the average. Where but occasional examinations were made, there was no appreciable reduction in the percentage of medical cases, but in establishments where physical examinations were conducted with any regularity the reduction was quite marked. With annual examinations, the average reduction was about 1½ per cent.; with examinations twice a year, a 5 per cent. improvement was general; and when physical examinations were made every three or four months the decrease in the average percentage of medical cases was very marked, close to 75 per cent. in the majority of cases. It is very doubtful if this heavy reduction could be counted upon in all plants, or that it is truly typical, but it does forcibly indicate the value of frequent regular physical examinations as an important aid in maintaining a high health standard.

In twenty of the forty-seven metal working establishments included in Mr. Alexander's report, attending physicians and nurses, or other trained assistants, are regularly carried on the payrolls of the companies and are on hand for any emergency, while in the balance regular physicians are employed part time, or are subject to call, and other medical assistance provided as the management has seen fit. The twenty plants maintaining regular medical staffs employ an aggregate of some 294,646 hands, while in the twenty-seven plants not so well cared for, but 79,931 workers are employed and the average cost of health supervision is materially higher. In a number of plants at which physicians are employed only part time, subject to call and where regular nurses are engaged in only some of the establishments, the average cost of health supervision is some 86.4 per cent. higher than the average cost in the forty-seven establishments.

With this very noticeable difference in the economy of health supervision in plants with and without regular medical staffs, it must be evident that any recommendations as to advisable size of staff, etc., should be based on the experience of those establishments that employ a regular corps of medical attendants. This is not difficult and should establish an efficient and well balanced staff for plants engaged in almost any of the industrial pursuits, quite as well as for those of the metal trades.

Based on the data presented in Mr. Alexander's report, therefore, the medical staffs which would promise to be best fitted to cope with the medical and surgical cases to be anticipated in the ordinary industrial establishments—medical staffs which would not only be qualified to rise to any probable emergency but which could also be maintained at a minimum expense commensurate with the necessity of adequate facilities and prompt attention in all cases—are: For establishments employing less than 3,000 hands, one physician and one nurse (male or female, as would be most appropriate for the particular establishment); for establishments carrying from 3,000 to 4,000 workers on the payroll, one physician and two nurses; one with 5,000 to 6,000 employees, two physicians and two nurses; while an establishment with from 7,000 to 10,000 workers would require for proper health supervision a staff of four doctors and eight nurses. In establishments employing more than 20,000 hands, a regular physician with two assisting nurses for each thousand employees appears to be the number required. In all industrial establishments, furthermore, additional physicians should be engaged, when possible, subject to call for service in cases of emergency. These recommended medical staffs are not only well balanced but should, under usual conditions, maintain the cost of health supervision per employee per year fairly constant in the respective establishments of a similar industry.

A comprehensive investigation into the cost of proper industrial health supervision for other trades, modeled after the foregoing study of the metal trades, could be made, but the data in Mr. Alexander's report pertaining to other classes of industry do not cover a sufficient number of establishments, nor represent a sufficiently large number of employees, to promise as reliable deductions as those applying to the metal trades.

In four of the establishments which submitted reports, health supervision had been extended to include that of employees' families at their homes and, though this materially increased the average cost of health supervision per employee, there is no question that everyone of the industries was materially benefited. The returns to the employer for his investment for proper supervision of the health of his employees are so great that he can well afford to look after the health of his employees' families, if it entailed an expenditure from which no profit was realized. A spirit of respect, loyalty and coöperation is engendered and no greater influence can be wielded to bridge the chasm which has developed between capital and labor.

Relation of Quantity Production to Cost

Labor Analysis of Manufacturing a Shaft in Lots of 1 to 200 Pieces

By A. G. Popcke

The importance of properly planning tool layouts in machine-shop manufacturing and determining the most economical size of lot is shown by the comparative productive labor costs of $2.24 for making a shaft singly, and 9.4 cents per shaft for a lot of 200. The analysis of this shaft also covers lots of 5, 10, 25, 50 and 100 pieces. The increase of cost due to loss of production from unused capacity ranges from 10 to 164 per cent.

The author, Mr. A. G. Popcke, *graduated from Cornell University in 1906, spent two years in the apprenticeship course of the Westinghouse Electric and Manufacturing Company, and since that time has been engaged in industrial engineering work for that firm, including the application of motors and motor control in metal-working plants. At present* Mr. Popcke *is supervising development work in connection with electric motors and their control in industrial plants.*

It is the desire of every manufacturer to increase his volume of profitable business to a maximum. To do so, it is necessary to obtain all production possible from existing machine-tool equipments. The majority of manufacturing establishments are equipped for the purpose of turning out standard appartus in certain predetermined quantities. However, a certain amount of special work must usually be carried on. In periods of dull business, manufacturers are willing to accept it to keep their shops busy. In periods of rush business, the manufacture of special business seriously retards the production of standard apparatus. It is the object of the following to discuss the points that should be taken into consideration in figuring the costs of producing special apparatus.

The tendency of salesmen is to sell anything they can in order to boost the volume of their sales. However, before the home office accepts business of a special nature, it must be carefully scrutinized. The departure from standard, the need of special features, the probable demand for these same features in the future, the extra cost and time required for making the modifications, the relations with the customers, the effect that refusal to quote will have on pending and future business—all must be given consideration, and quotation only made if all of these conditions are especially favorable. High prices are usually quoted. The salesman can help his home office considerably by discouraging the specifications by customers of features differing from standard practice. The alert salesman learns in advance the needs of his customers and by a little well placed argument can swing the requirements into line with standards and produce the greatest profits. Standards are usually selected to meet prevailing demands. In this way the salesman renders good service to both his company and his customer.

The better a shop is organized to manufacture its product economically, the greater will be the cost of special modifications. A well systemized shop is arranged so that an order for a standard design can be placed and filled with the least possible expense. Manufacturing information is permanent and clerical work is minimized. Materials are ordered in advance and in quantities to take advantage of best market conditions. The various processes in connection with manufacture are performed economically. Permanent tools are made, and when a machine is adjusted for a given process it can be employed at that process long enough to minimize the cost.

The progress of such work through the plant can be systemized and the machines arranged for most economical handling of materials. Manufacturing conditions can be made ideal and costs reduced to the lowest possible point only when a shop can be devoted to one line of work, turning out one standard product, just as a workman can become most expert at a given operation when he devotes his whole time and attention to that operation. Under such shop conditions the overhead expense can be made very small, and other advantages follow.

Products of a special nature are not only more expensive in themselves, but they add to the cost of all standard apparatus going through the shop. It is doubtful if any manufacturer who is attempting to produce both standards and specials fully realizes the extra expense that specials cost him. Any departure whatever from standard requires some special attention. Special orders and increased correspondence, special inspection, all add to the cost to a degree not ordinarily appreciated. Specials are rarely required in large quantities; the larger the quantities, the more nearly the special comes to a standard and the lower the unit cost until the minimum for ideal conditions is reached. For specials as generally ordered, materials must be requisitioned in small quantities and under disadvantageous market conditions. Work must be performed with inadequate tools because the expense of proper tools is not warranted. When tools are available they must be set up and adjustments made for performing work that often requires less time than the adjustments themselves. The arrangement of tools and the methods of handling work must be prescribed with such specials in view. The special work retards the progress of standard work by utilizing the time of men and machines that could be more efficiently employed on standard processes. Efficient progress of work is frequently impossible with specials; the handling of materials cannot be so well planned as with standards nor the time of machines and operators so well utilized. Operators who are expert and efficient at a standard process may work very inefficiently at special work which probably does not last long enough for them to acquire proficiency.

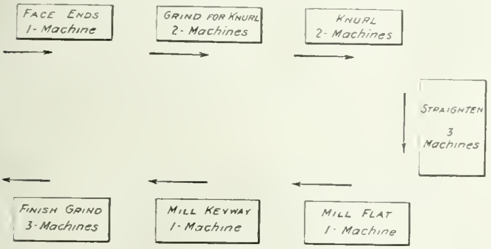


FIG. 1. TOOL LAYOUT IN ORDER OF SEQUENCE OF OPERATIONS
Laid Out to Produce 47 Shafts Per Hour in Lots of 200.

TABLE 1
TIME TO PRODUCE BY OPERATIONS

Operation	Time in Hours				Time per Piece						Number of Pieces per Hour						
			Total		Lots of						Lots of						
	Set Up	Machining	First Piece	Each Additional Piece	5	10	25	50	100	200	1	5	10	25	50	100	200
Face Ends . . .	.387	.013	40	013	09	05	028	021	.017	015	2	11	20	35	47	59	66
Grind for Knurl .	.39	04	.43	.04	118	079	056	048	044	042	2	8	12	18	20	23	24
Knurl	.196	.034	.23	034	073	054	042	038	036	035	4	13	18	23	26	27	28
Straighten . .	.10	05	15	05	07	06	054	052	051	05	6	14	16	18	19	19	20
Mill Flat . .	.483	.017	.50	017	114	065	036	027	.022	019	2	8	15	27	37	45	52
Mill Keyway . .	.33	.02	.35	020	086	053	.033	027	.023	021	3	11	19	30	37	43	47
Finish Grind . .	.271	.059	.33	059	113	.086	07	065	.062	06	3	8	11	14	15	16	16

LABOR COST OF MAKING SHAFTS

To show in dollars and cents the effect upon cost when producing machine parts not conforming exactly to standard in line with a predetermined layout, the cost of producing shafts will be discussed in detail.

Before an operation can be accomplished on any machine tool, it is necessary to set up the cutting tools and make the necessary adjustments which have been decided upon to produce the job most economically. The time to make these adjustments is the same whether one piece or 100 or more pieces are produced. Thus the total time to produce each decreases with the quantity of the lot machined; actual values are given in the following discussion.

The operations required to complete the shafts after they are rough turned and centered are as follows:

1. face ends; 2. grind for knurl; 3. knurl; 4. straighten; 5. mill flat; 6. mill keyway; 7. finish grind.

The machines for performing these operations are arranged in the same sequence as the operations are performed, making very little trucking necessary. One man completing an operation sets his work aside where the next man can pick it up. See Figure 1.

Any shafts that have special operations on them interfere with this flow and cause congestion and delay.

A certain amount of scrap is unavoidable, which in the case of standard shafts can be taken from stock and replaced at small expense when the next lot is made, but the scrapping of a special shaft may necessitate the bringing through of one shaft alone at an extremely high cost, as will be explained by figures given below. It also requires more supervision and inspection than a large quantity of standard shafts.

Table 1 shows the relation of time to produce one piece when made in quantity lots of 1, 5, 10, 25, 50, 100 and 200. The set up time and the time to complete machine work are given. The sum of these is the time to produce one piece. The time to produce each piece after the first is completed is equal to the machining time. From these values the time required to produce each piece in the quantities shown are figured. With the latter as a basis, the number of pieces produced per hour per tool are calculated.

Table 2 gives the cost of labor to produce these shafts when made in the quantity lots given in Table 1. The hourly rate per operator is given in the first column. The cost of labor per operation is figured on the basis of a bonus system. The cost of labor is equal to: *Time to complete x hourly rate x 1.30* if completed in the time specified. If not completed in this time, it is figured on a straight hourly basis. For example, to face ends of one shaft requires 0.4 hours, and at an hourly rate is 22 cents, the cost to make the first piece is 0.4 × 0.22 × 1.30 = $0.1145.

The cost of labor figured on this basis is the minimum. In case the operation is not completed in the time specified, the operator will not earn his bonus, resulting in an increased cost of the operation. Then both operator and employer are losers. In the above case if 0.5 hours were required instead of 0.4 hours the cost would be 0.5 × 0.22 = $0.11 and the operator would be paid on his regular hourly rate. The object of the bonus system is to meet or better the time required to complete an operation.

TABLE 2

LABOR COST OF OPERATIONS

Operation	Hourly Rate Cents	Cost		Cost per Piece in Lots of					
		First Piece	Each Additional Piece	5	10	25	50	100	200
Face Ends	22	$.1145	$.0037	$ 026	$ 015	$.008	$.006	$ 005	$ 004
Grind for Knurl	32	.1785	.0166	.049	.033	.023	020	.018	.017
Knurl	22	.0657	0097	.021	015	.012	011	010	010
Straighten	22	.0429	0143	.020	.016	.015	.014	014	.014
Mill Flat	28	.1820	0062	.041	.024	.013	.011	008	.007
Mill Keyway	28	.1275	.0073	.031	019	.012	.010	008	.008
Finish Grind	32	.1370	0247	.045	036	.029	027	026	.025
Totals		$ 8481		$ 233	$.158	$ 112	$ 099	$.089	$ 085

A study of the number of pieces per hour produced under the various operations in a given quantity lot shows considerable variation (see Table 1). If only one tool is available for each operation, economical production in large quantity lots cannot be obtained. For a uniform flow of production, based on producing in lots of 200, one tool is sufficient for facing ends, two are required to grind for knurling, two are required for the knurling operation, three for straightening, one for milling flat, one for milling keyway and three for finish grinding.

With this tool equipment as a basis for most economical production, Table 3 gives an analysis of what happens when shafts are brought through in smaller quantity lots. The number of pieces produced per hour per tool (values obtained from Table 1), number of tools, total output, overproduction of each tool when compared with the operation which limits production (milling keyway and milling flat in this example), the labor of each piece (obtained from Table 2), total value of overproduction. The overproduction should be considered as a loss, since it is not carried out on the tools where it occurs and, therefore, represents a loss in possible production time of these equipments. The cost figured for the operation is based on turning out shafts in the quantities per hour per tool given.

TABLE 3

ANALYSIS OF OUTPUT IN VARIOUS QUANTITY LOTS

	Lots of 200					
	No. Pieces	Tools	Output	Over-Production	Value per Unit	Total Value
Face Ends	66	1	66	19	.004	076
Grind for Knurl	24	2	48	1	017	017
Knurl	28	2	56	9	.010	090
Straighten	20	3	60	13	014	.182
Mill Flat	52	1	52	5	007	035
Mill Keyway	47	1	47	0	008	0
Finish Grind	16	3	48	1	.025	025
					Total	.425

	Lots of 100					
	No. Pieces	Tools	Output	Over-Production	Value per Unit	Total Value
Face Ends	59	1	59	16	.005	080
Grind for Knurl	23	2	46	3	018	.054
Knurl	27	2	54	11	.010	.110
Straighten	19	3	57	14	.014	.196
Mill Flat	45	1	45	2	.008	.016
Mill Keyway	43	1	43	0	.008	0
Finish Grind	16	3	48	5	026	.130
					Total	.586

	Lots of 50					
	No. Pieces	Tools	Output	Over-Production	Value per Unit	Total Value
Face Ends	47	1	47	10	.006	.060
Grind for Knurl	20	2	40	3	.020	.060
Knurl	26	2	52	15	.011	.165
Straighten	19	3	57	20	.014	.280
Mill Flat	37	1	37	0	011	0
Mill Keyway	37	1	37	0	.010	0
Finish Grind	15	3	45	8	.027	.216
					Total	.781

	Lots of 25					
	No. Pieces	Tools	Output	Over-Production	Value per Unit	Total Value
Face Ends	35	1	35	8	008	064
Grind for Knurl	18	2	36	9	.023	.207
Knurl	23	2	46	19	012	228
Straighten	18	3	54	27	015	405
Mill Flat	27	1	27	0	.013	0
Mill Keyway	30	1	30	3	012	036
Finish Grind	14	3	42	15	029	435
					Total	1 375

	Lots of 10					
	No. Pieces	Tools	Output	Over-Production	Value per Unit	Total Value
Face Ends	20	1	20	5	.015	.075
Grind for Knurl	12	2	24	9	.033	.296
Knurl	18	2	36	23	.015	.345
Straighten	16	3	48	33	.016	.528
Mill Flat	15	1	15	0	.024	0
Mill Keyway	19	1	19	4	.019	.076
Finish Grind	11	3	33	18	.036	.650
					Total	1.970

	Lots of 5					
	No. Pieces	Tools	Output	Over-Production	Value per Unit	Total Value
Face Ends	11	1	11	3	.026	.078
Grind for Knurl	8	2	16	8	.049	.392
Knurl	13	2	26	18	.021	.380
Straighten	14	3	42	34	.020	.680
Mill Flat	8	1	8	0	.041	0
Mill Keyway	11	1	11	3	.031	093
Finish Grind	8	3	24	16	045	.720
					Total	2.343

	Lots of 1					
	No. Pieces	Tools	Output	Over-Production	Value per Unit	Total Value
Face Ends	2	1	2	0	.115	0
Grind for Knurl	2	2	4	2	179	.358
Knurl	4	2	8	6	.066	.396
Straighten	6	3	18	16	043	.688
Mill Flat	2	1	2	0	.182	0
Mill Keyway	2	1	5	3	.128	384
Finish Grind	3	3	9	7	137	.959
					Total	2.785

This loss in time can be expressed as follows considering making shafts in quantity lots of 200:

Number of shafts produced per hour	47
Loss due to overproduction on tools (see Table 3)	$0.425

Loss per shaft	$0.009
Cost per shaft (see Table 3)	$0.085
Total cost per shaft	$0.094
Increase in cost due to loss in production	10%

Table 4 shows how this loss rapidly increases as the quantity lots are decreased.

Thus if a production system is laid out to produce economically in quantities of 200, bringing through smaller quantity lots produces a large increase in cost not only in the time lost in setting up, but also due to unequalized production produced due to the different relative time required to carry out the various operations.

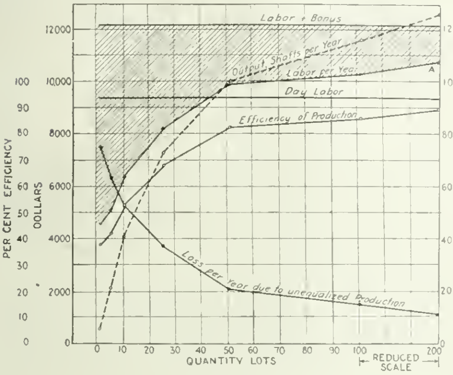


FIG. 2. RELATION OF (YEARLY OUTPUT) (EFFICIENCY OF PRODUCTION) TO QUANTITY LOTS OBTAINED BY OPERATING LAYOUT OF MACHINES SHOWN IN FIG. 1.

On the basis of operating 2700 hours per year, the maximum production possible is as follows, based on making the shaft in quantity lots as indicated:

Quantity Lots	Shafts per Hour	Output per Year
200	47	127,000
100	43	116,000
50	37	100,000
25	37	73,000
10	15	40,500
5	8	21,600
1	2	5,400

The total labor per year is as follows:

Quantity Lots	Labor per Shafts	Number of Shafts per Year	Labor per Year
200	$.085	127,000	$10,800
100	.089	116,000	10,300
50	.099	100,000	9,900
25	.112	73,000	8,200
10	.158	40,500	6,400
5	.233	21,600	5,040
1	.848	5,400	4,585

The yearly loss in production based on the data given in Table 3 is as follows:

Quantity Lots	Loss per Hour	Loss per Year of 2700 Hours
200	$ .425	$1,150
100	.586	1,580
50	.781	2,110
25	1.375	3,710
10	1.970	5,320
5	2.343	6,340
1	2.785	7,500

The sum of total labor charged to shafts per year and the yearly loss in production due to unequalized production is as follows:

Quantity Lots	Value of Labor per Year on Shafts	Loss per Year	Total
200	$10,800	$1,150	$12,350
100	10,300	1,580	11,880
50	9,900	2,110	12,010
25	8,200	3,710	11,910
10	6,400	5,320	11,720
5	5,040	6,340	11,380
1	4,580	7,500	12,080
		Average	$11,900

The total yearly labor figured from the hourly rate of operators is as follows:

Operation	Number of Machine	Hourly Rate per Operator	Total Hourly Rate
Face ends	1	$ .22	$ .22
Grind for knurl	2	.32	.64
Knurl	2	.22	.44
Straighten	3	.22	.66
Mill flat	1	.28	.28
Mill keyway	1	.28	.28
Finish grind	3	.32	.96
		Total	$3.48

Total yearly labor, 2700 × 3.48 = $9,400.

On the basis that the operators earn 30 per cent. bonus if they complete the operation given in Table 1 in the time specified, the total yearly labor is 1.30 × 9,400 = $12,200.

This figure checks within 2 per cent. of the figure given in discussion above under sum of value of labor per year on the shaft and loss of labor due to unequalized production.

Figure 2 shows these values graphically.

With this data it is possible to determine the relative efficiency of production when producing in various quantity lots. The value of input in this case may be considered equivalent to $12,000 per year, and the value of output the value of labor per year chargeable to the shafts actually considered in figuring labor cost. Thus the shaded portion above the curve representing labor charged to the shafts is the loss due to unequalized production and this amount is not ordinarily included in the labor cost.

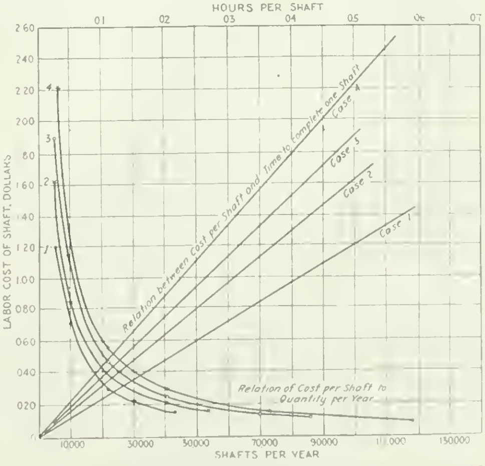


FIG. 3. RELATION OF (1) COST PER SHAFT TO QUANTITY PRODUCED PER YEAR, (2) TIME TO COMPLETE ONE SHAFT AND COST PER SHAFT

TABLE 4

AN ALYSIS OF LABOR COSTS IN VARIOUS QUANTITY LOTS

Lots of	1	5	10	25	50	100	200
Number of Shafts per Hour	47	43	37	27	15	8	2
Loss Due to Unequalized Production per Hour	.425	.586	.781	1 375	1 970	2 343	2.785
Loss per Shaft	.009	.014	.021	.051	131	.292	1.39
Labor per Shaft (Table 2)	.085	.089	.099	.112	.158	.233	.848
Total Labor per Shaft	.094	103	.120	.163	289	.525	2 238
Per Cent Increase Due to Loss in Production	10	16	21	45	83	125	165

With the system of production just discussed, most economical production results when shafts are manufactured in quantity lots of 200 and when the total labor cost per year (2700 hours) is $12,000, 127,000 shafts being produced. Thus any job which tends to decrease this output should be charged with the labor lost. Bringing through shafts in smaller quantities reduces this production, and for this reason the cost per shaft in smaller quantity lots should be obtained by dividing $12,000 by the yearly production that is possible at the quantity lot under consideration. Thus, the cost per shaft should be as follows for the various quantity lots referred to in the above discussion:

Quantity Lots	Shafts per Year	Cost per Shaft—12,000 ÷ Shafts per Year
200	127,000	$ .095
100	116,000	.113
50	100,000	.12
25	73,000	.164
10	40,500	.298
5	21,600	.555
1	5,400	2.22

These same values are obtained by dividing the values given in Table 2 by the efficiency of production and are shown in tabular form below, referring to the same quantity lots, from 200 down to 1, and giving the total cost per shaft and the efficiency.

Quantity Lots	Cost Obtained From Table 2	Efficiency of Production Per Cent.	Total Cost of Shaft	Time to Complete 1 Shaft, Hour
200	$ .085	90	$ .095	.021
100	.089	86	.113	.023
50	.099	82.5	.12	.027
25	.112	68	.164	.037
10	.158	53	.298	.067
5	.233	42	.555	.125
1	.848	48	2.22	.500

Figure 3 gives the relation between the cost of the shaft and quantities that can be produced per year (the hyperbolic curve). The straight line shows the relation between the time to complete one shaft and the cost per shaft, on the basis of total labor per year equalling $12,000.

On the basis that the shop is working full capacity, these curves can be used in estimating the cost of labor chargeable to a special shaft, if the time to produce the latter in any quantity is known. The labor chargeable to it is equal to the cost of labor equivalent to the

TABLE 5

ANALYSIS OF OUTPUT IN VARIOUS QUANTITY LOTS PRODUCED ON THREE DIFFERENT ARRANGEMENTS OF TOOLS

Operation	Lots of 1						Lots of 5						Lots of 10						Lots of 25					
	No. Pieces	Tools	Output	Over-Production	Value per Unit	Total Value	No. Pieces	Tools	Output	Over-Production	Value per Unit	Total Value	No. Pieces	Tools	Output	Over-Production	Value per Unit	Total Value	No. Pieces	Tools	Output	Over-Production	Value per Unit	Total Value
Case 1																								
Face Ends	2	1	2	0	.115	0	11	1	11	3	.026	.078	20	1	20	9	.015	.135	35	1	35	21	.008	.168
Grind for Knurl	2	1	2	0	179	0	8	1	8	0	.049	0	12	1	12	1	033	033	18	1	18	4	.023	.092
Knurl	4	1	4	2	066	.132	13	1	13	5	.021	.105	18	1	18	7	015	105	23	1	23	9	.012	.108
Straighten	6	1	6	4	043	.172	14	1	14	6	.020	.120	16	1	16	5	.016	080	18	1	18	14	015	.210
Mill Flat	2	1	2	0	.182	0	8	1	8	0	.041	0	15	1	15	4	.024	096	27	1	27	13	.013	.169
Mill Keyway	2	1	2	0	.128	0	11	1	11	3	.031	.093	19	1	19	8	.019	.152	30	1	30	16	012	.192
Finish Grain	3	1	3	1	.137	.137	8	1	8	0	.045	0	11	1	11	0	.036	0	14	1	14	0	029	0
					Total	.441					Total	.396					Total	.601					Total	.939
Case 2																								
Face Ends	2	1	2	0	.115	0	11	1	11	3	.026	.078	20	1	20	5	.015	.075	35	1	35	17	.008	.136
Grind for Knurl	2	2	4	2	.179	.358	8	2	16	8	.049	.392	12	2	24	9	.033	.297	18	2	36	18	.023	.415
Knurl	4	1	4	2	.066	.132	13	1	13	5	.021	.105	18	1	18	3	.015	.045	23	1	23	5	.012	.060
Straighten	6	1	6	4	.043	.172	14	1	14	6	.020	.120	16	1	16	1	.016	016	18	1	18	0	.015	0
Mill Flat	2	1	2	0	.182	0	8	1	8	0	.041	0	15	1	15	0	.024	0	27	1	27	9	.013	.117
Mill Keyway	2	1	2	0	.128	0	11	1	11	3	.031	.093	19	1	19	4	.019	.076	30	1	30	12	012	.144
Finish Grind	3	2	6	4	.137	.548	8	2	16	8	.045	.360	11	2	22	7	.036	.252	14	2	28	10	.029	.290
					Total	1.210					Total	1.148					Total	.761					Total	1.162
Case 3																								
Face Ends	2	1	2	0	.115	0	11	1	11	3	.026	.078	20	1	20	5	.015	.075	35	1	35	8	.008	.064
Grind for Knurl	2	2	4	2	.179	.358	8	2	16	8	.049	.392	12	2	24	9	033	.297	18	2	36	9	.023	.207
Knurl	4	2	8	6	.066	.396	13	2	26	15	.021	.315	18	2	36	21	.015	.315	23	2	46	19	.012	.228
Straighten	6	2	12	10	.043	.430	14	2	28	17	.020	.340	16	2	32	17	.016	.272	18	2	36	9	015	.135
Mill Flat	2	1	2	0	.182	0	8	1	8	0	.041	0	15	1	15	0	.024	0	28	1	27	0	013	0
Mill Keyway	2	1	2	0	.128	0	11	1	11	3	031	.093	19	1	19	4	019	.076	30	1	30	3	012	.036
Finish Grind	3	2	6	4	.136	.548	8	2	16	8	.045	.3 0	11	2	22	7	.03	.252	14	2	28	1	.029	.029
					Total	1.732					Total	1.528					Total	1 278					Total	.699

time lost in the production of standard shafts. For example, if the time required to produce a special shaft is 0.3 hour, its labor cost is $1.34. If only this shaft were produced each requiring 0.3 hours, the yearly output would be 9,000 shafts, the total yearly labor being 1.34 × 9,000 = $12,000.

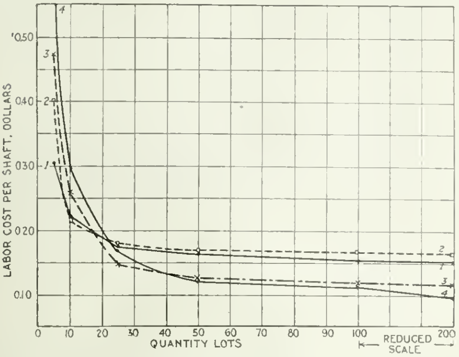


FIG. 4. COST PER SHAFT

Case 1. Cheapest Up to Lots of 5; Max. Output—43200 yr.
Case 2. " In Lots of 10-15; " " —54000 "
Case 3. " " " " 15-40; " " —86500 "
Case 4. " " " " 40-200;

An inspection of the curves in Figure 2 shows that curve *A* crosses the day labor line at a production obtainable in manufacturing lots of 42, equivalent to a total production of 94,000 shafts per year. It, therefore, does not pay to operate the bonus system of production just discussed when shafts are brought through in average quantities less than 42. Let us, therefore, consider other arrangements of tools and their effect upon cost of production, efficiency of production, etc.

The following cases will be considered:

Case 1. One tool for each operation
Case 2. One tool for each operation, except two for *grind for knurl* and two for *finish grind.*
Case 3. One tool for *facing ends, mill flat* and *mill keyway,* two tools for each of the remaining operation.

Table 5 gives an analysis for each case similar to that given in Table 3. The data in Table 3 will hereafter be referred to as Case 4.

In Table 6 is a summary of output per year, labor per shaft, labor per year directly chargeable to shaft, loss per hour and per year due to unequalized production, total cost, efficiency of production and cost per shaft. These values are all obtainable as outlined in the discussion above, which covers the arrangement of tools for Case 4.

Figure 4 gives a graphic representation of the relative costs per shaft when made on equipments 1, 2, 3 or 4, in the quantity lots indicated. This shows that equipment 1 produces shafts more economically than any of the others given, when made in quantities not exceeding 5. The maximum output in a year of 2,700 hours is limited to 43,200 shafts. This equipment is, therefore, the most economical to use in shops where the output does not exceed this limiting value and where there is a large amount of special work in small quantity lots. Equipment 2 produces more economically than either 1, 3 or 4 in quantity lots of 10 to 15; its maximum output per year (2,700 hours) is limited to 54,000 shafts. With equipment 3 shafts are made cheaper than with the other equipments under discus-

TABLE 5—Continued

ANALYSIS OF OUTPUT IN VARIOUS QUANTITY LOTS PRODUCED ON THREE DIFFERENT ARRANGEMENTS OF TOOLS

Operation	Lots of 50						Lots of 100						Lots of 200					
	No. Pieces	Tools	Ou-t put	Over-Pro-duc-tion	Value per Unit	Total Value	No. Pieces	Tools	Out-put	Over-Pro-duc-tion	Value per Unit	Total Value	No. Pieces	Tools	Out-put	Over-Pro-duc-tion	Value per Unit	Total Value
Case 1																		
Face Ends	47	1	47	32	.006	.192	59	1	59	43	.005	.215	66	1	66	50	.004	.200
Grind for Knurl	20	1	20	5	.020	.100	23	1	23	7	.018	.126	24	1	24	8	.017	.136
Knurl	26	1	26	9	.011	.099	27	1	27	11	.010	.110	28	1	28	12	.010	.120
Straighten	19	1	19	4	.014	.056	19	1	19	3	.014	.042	20	1	20	4	.014	.056
Mill Flat	37	1	37	22	.011	.242	45	1	45	29	.008	.232	52	1	52	36	.007	.252
Mill Keyway	37	1	37	22	.010	.220	43	1	43	27	.008	.216	47	1	47	31	.008	.248
Finish Grind	15	2	30	11	.027													
						.909					Total	1.041					Total	1.012
					Total													
Case 2						.168	59	1	59	40	.005	.200	66	1	66	46	.004	.184
Face Ends	47	1	47	28	.006	.420	23	2	46	27	.018	.486	24	2	48	28	.017	.476
Grind for Knurl	20	2	40	21	.020	.077	27	1	27	8	.010	.180	28	1	28	8	.010	.080
Knurl	26	1	26	7	.011	0	19	1	19	0	.014	0	20	1	20	0	.014	0
Straighten	19	1	19	0	.014	.198	45	1	45	26	.008	.208	52	1	52	32	.007	.224
Mill Flat	37	1	37	18	.011	.180	43	1	43	24	.008	.192	47	1	47	27	.008	.216
Mill Keyway	37	1	37	18	.010	.297	16	2	32	13	.026	.338	16	2	32	12	.025	.300
Finish Grind	15	2	30	11	.027	.297	16	2	32	13	.026	.338	16	2	32	12	.025	.300
					Total	1.340					Total	1.604					Total	1.480
Case 3																		
Face Ends	47	1	47	17	.006	.102	59	1	59	27	.005	.135	66	1	66	34	.004	.136
Grind for Knurl	20	2	40	10	.020	.200	23	2	46	14	.018	.252	24	2	48	16	.017	.272
Knurl	26	2	52	22	.011	.242	27	2	54	22	.010	.220	28	2	56	24	.010	.240
Straighten	19	2	38	8	.014	.112	19	2	38	6	.014	.084	20	2	40	8	.014	.112
Mill Flat	37	1	37	7	.011	.077	45	1	45	13	.008	.104	52	1	52	20	.007	.140
Mill Keyway	37	1	37	7	.010	.070	43	1	43	11	.008	.088	47	1	47	15	.008	.120
Finish Grind	15	2	30	0	.027	0	16	2	32	0	.026	0	16	2	32	0	.025	0
					Total	.803					Total	.883					Total	1.20

sion in quantities of 15 to 40, the maximum output per year being limited to 86,500 shafts. Equipment 4, discussed above in detail, is the most economical for a large shop producing standards in large quantities. It is most economical when the quantity lots exceed 40, but the cost per shaft is higher than if made on equipments 1, 2 and 3, if quantities less than 20 are produced. This brings out clearly the excessive costs of special shafts, made in small quantities when made in a shop to produce large quantities.

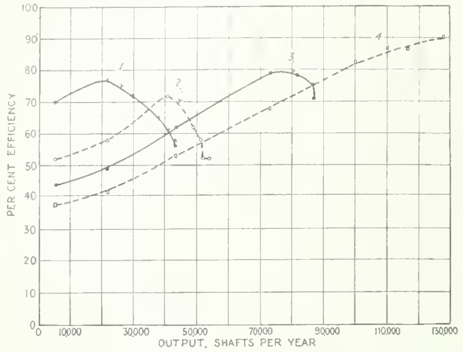


FIG. 5. EFFICIENCY OF PRODUCTION

Up to 30000 Shafts Per Yr. Case 1. Most Economical. From 30000 to 45000 Shafts Per Yr. Case 2. Most Economical. From 45000 to 86000 Shafts Per Yr. Case 3. Most Economical. From 86000 to 130000 Shafts Per Yr. Cast 4. Most Economical.

Figure 5 gives the relation of efficiency of production and number of shafts produced per year for equipments 1, 2, 3 and 4. Note the gradual increase to a certain economical quantity in each case, beyond which the efficiency drops off rapidly due to the increase in loss, clearly due to unequalized production.

These curves also show clearly the rapid decrease in efficiency of production when making small quantity lots on equipments laid out to handle large quantities. Note also the increase in efficiency when producing at most economical quantities, as the capacity of the plant increases. The limit in production, shafts per year (2,700 hours) is clearly shown.

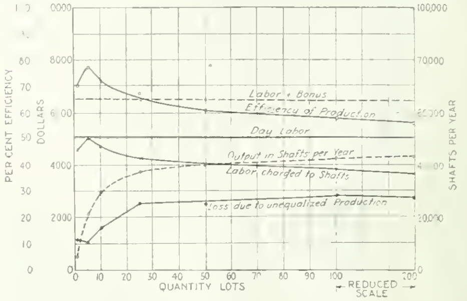


FIG. 6-A. CASE I. RELATION OF COST AND EFFICIENCY OF PRODUCTION TO QUANTITY LOTS

Figure 6 shows the relation for equipments 1, 2 and 3 shown in Figure 2 for equipment 4, the details of which have been discussed on pages 55, 56. A study of Case 1 shows that only in lots of 5 is the labor chargeable to the shaft equal to the total day labor. In this case, therefore, the bonus system could not be used except on the machine which determines the rate of output. On the remaining machines even a day rate is not economical because of the unequalized production causing the operator on the machine, which could overproduce shafts (see Table 5), to wait for work

TABLE 6

Analysis of Production and Labor Cost on Various Equipments in Various Quantity Lots

	Quantity Lots	Output per Hour	Time per Shaft Hour	Output per Year	Labor per Shaft	Labor per Year	Loss Due to Unequalized Production		Total	Efficiency of Production	Cost per Shaft	Labor per Year Paid to Operators on Basis of	
							Per Hour	Per Year				Day Rate	WithBonus
CASE 1	1	2	.5	5,400	$.848	$4,570	$ .441	$1,190	$5,760	70%	$1.21	$5,020	$6,550
	5	8	125	21,600	.233	5,030	.396	1,070	6,100	77	.304		
	10	11	091	29,700	.158	4,700	.601	1,620	6,320	72	.220		
	25	14	071	37,800	112	4,240	939	2,530	6,770	65	.173		
	50	15	067	40,500	099	4,010	.909	2,480	6,490	61	.162		
	100	16	.063	43,200	089	3,840	1 041	2,820	6,660	58	152		
	200	16	.063	43,200	.085	3,670	1.012	2,730	6,400	56	.152		
CASE 2	1	2	.5	5,400	.848	4,570	1.21	3,260	7,830	52	1 62	6,750	8,750
	5	8	.125	21,600	.233	5,030	1.148	3,100	8,130	58	.405		
	10	15	067	40,500	158	6,400	.761	2,055	8,455	73	.216		
	25	18	055	48,600	112	5,450	1.162	3,140	8,590	62	.180		
	50	19	053	51,300	099	5,060	1.340	3,620	8,680	58	.170		
	100	19	053	51,300	.089	4,560	1.604	4,330	8,890	52	.170		
	200	20	05	54,000	085	4,590	1.480	4,000	8,590	52	.162		
CASE 3	1	2	.5	5,400	.848	4,570	1.732	4,680	9,250	44	1.91	7,950	10,300
	5	8	.125	21,600	.233	. 5,030	1.578	4,260	9,290	49	.477		
	10	15	067	40,500	.158	6,400	1.287	3,470	9,870	62	.254		
	25	27	037	73,000	112	8,180	.699	1,890	10,070	79	.141		
	50	30	.033	81,000	.099	8,020	.803	2,170	10,190	78	.127		
	100	32	.031	86,500	.089	7,700	.883	2,380	10,080	75	.119		
	200	32	031	86,500	.085	7,350	1.020	2,760	10,110	71	.119		
CASE 4	1	2	.5	5,400	.848	4,585	2.785	7,500	12,080	38	2.22	9,400	12,200
	5	8	.125	21,600	.233	5,040	2.343	6,340	11,380	42	.555		
	10	15	067	40.500	.158	6,400	1.970	5,320	11,720	53	.298		
	25	27	.037	73,000	.112	8,200	1.375	3,710	11,910	68	.164		
	50	37	.027	100,000	.099	9,900	.781	2,110	12,010	82.5	.120		
	100	43	.023	116,000	089	10,300	.586	1,580	11,880	86	.113		
	200	47	.021	127,000	.085	10,800	.425	1,150	12,350	90	.095		

from the machines which determine the rate of production.

The same is true of Case 2, where in general even the total labor charged to shaft does not equal the total day labor. In Case 3 the total day labor directly chargeable to shaft exceeds total day labor in quantities of 23 to 54, which indicates that the bonus system would only pay on the machines which determine the rate of production. In Case 4 Figure 2 which was discussed in detail before, the bonus system pays on the majority of tools (all except those operating under capacity when lots of greater than 40 are produced).

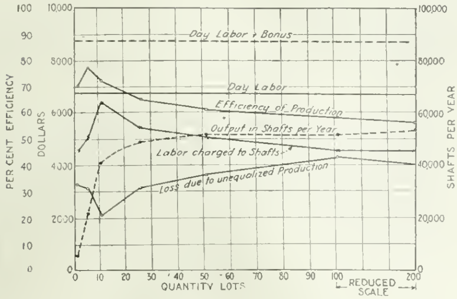


FIG. 6-B. CASE 2. RELATION OF COST AND EFFICIENCY OF PRODUCTION TO QUANTITY LOTS

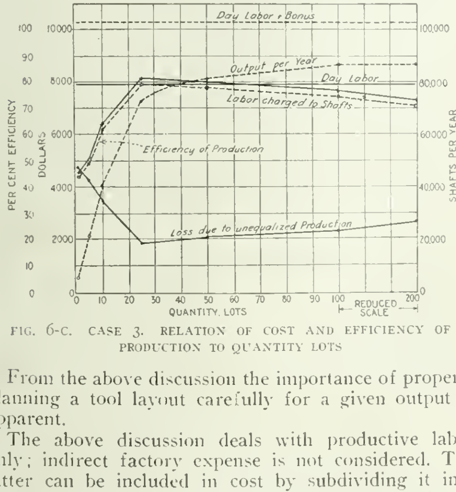


FIG. 6-C. CASE 3. RELATION OF COST AND EFFICIENCY OF PRODUCTION TO QUANTITY LOTS

From the above discussion the importance of properly planning a tool layout carefully for a given output is apparent.

The above discussion deals with productive labor only; indirect factory expense is not considered. The latter can be included in cost by subdividing it into machine-hour rates chargeable to each tool. This charge is usually equal to, or greater than, the operator's hourly rate of wages. All relations discussed in connection with flat labor would also apply to the machine-hour rates.

Business After the War--Discussion

By Franklin P. Wood

Chairman, Las Animas County Colorado Council of Defense

THE paper "What Will Business Be After the War," by Mr. J. P. Brophy, in the December issue of INDUSTRIAL MANAGEMENT, covers a subject of vast importance. There are many sides to this important question and it behooves intelligent people not to be caught napping. Business may suffer, there is the possibility that the very life of the nation may be threatened and a state of chaos approaching that of Russia today may be produced. No one doubts the ability of the American people ultimately to work out the problem satisfactorily, but why the use of strife and contention when forethought and preparedness may eliminate the useless waste that goes with an industrial depression. While we are entirely absorbed in the conduct of the world war, and perhaps anxiously awaiting the outcome, although none of us doubts what this will be, it is well to turn our thoughts to the time when peace shall come.

Much has been made of the conditions of lack of preparedness in which we found ourselves at the beginning of the war. The thoughtful will ask, are we today any better prepared to have peace come?

OUR CHANGE IN THINKING

The world is becoming accustomed to think in terms of 17-inch guns, dreadnaughts, and mighty steel monsters of the sea dealing destruction to those unprepared for defense. We are becoming accustomed to think of money in terms, not of paltry millions, but of billions. Liberty loans, the Red Cross, the Y. M. C. A. drive, all bring to the conscience of this great people the vast resources to which they have access.

And after all, this but reflects the great impelling force of thought which is ever at work. Keyed up by the thought of *Liberty* for all mankind, we are willing to undertake stupendous tasks. The irresistible force of this unified action can have but one outcome, sooner or later the world will be made "safe for democracy."

However, mob rule still holds sway. We are not yet developed to the stage in which we can entirely, calmly and dispassionately work out the problems which confront humanity. The scare produced by the advent of war created a panic for a time; chaos seemed to threaten our national life. The actual progress of the war producing the most awful destruction on one side of the Atlantic, created prosperity for us never before experienced. It would not be impossible to imagine a vast number of industries built up by the demands of the war, closing down as soon as the war is over.

It is quite easy to imagine the financial world, always tickle, settling down for a period of despair. There is no need to dwell on the results of such a condition of affairs; one can imagine such a state coming to pass.

WORK OF RESTORATION

On the other hand, there is the possibility of an entirely different condition. The ravages of war have laid waste large areas of land, destroyed factories, cities, shipping; disabled man power and produced a condition that will take years and years to restore to a normal state. This restoration will require the resources of the nations for years to come. Will the depleted financial condition be equal to the task, at least without a longer or shorter period of reconstruction? During this time it is not likely that labor, accustomed to high wages and plentiful work, will settle back to its antebellum condition without a serious objection. No matter whether these objections are foundationless or not, it is too much to expect that labor will yield to changed conditions without a struggle.

As has been pointed out the belligerent nations of Europe are facing the end of the war with the prospect of exhaustion. Every month the war continues, this process of exhaustion continues. This includes manpower, financial power, and to a cert in extent industrial power, and loss of markets.

Reproduction Cost in Industrial Appraisement

By Charles W. McKay

After discussing seven important questions that present themselves to the industrial manager in connection with an appraisal the author offers this suggestion: "Give your industrial appraisal problem just as much careful thought as you would accord to any other branch of management, and when you are confronted with a phase of the problem that is beyond you, don't try to bluff it through, but call in a specialist."

Mr. Charles W. McKay *has been engaged in engineering and appraisal work since graduating from Cornell University in 1906. He has been associated with the New York Telephone Company, Henry Floy, and the McCall and Clark Company. At present he is affiliated with the engineering firm of McMeen and Miller, devoting the major part of his time to problems of utility and industrial appraisement.*

In taking up the problem of appraising any industrial property there are several questions which must be considered most carefully. In the order in which they would probably present themselves to an industrial manager, these questions are:

1. Should the inventory and appraisal be made by a disinterested expert, or by the company owning the property?
2. How long will the appraisal take and how much will it cost?
3. What records are available which may be used as an aid to the appraisement?
4. What type of men should be employed—both for field and for office work?
5. What forms are necessary for tabulating the data?
6. What is the best method of making the actual count of the physical property?
7. What is the best method of building up the unit costs?

Each of these questions is well worth serious consideration. A careful preliminary review of the situation may save a good deal of unnecessary expense. While it is impractical to lay down any definite set of rules that will apply to all industrial appraisal problems, it is possible to draft a general program which, with variations, will be applicable to all industrial appraisals.

> Seven appraisal questions:
> Should the inventory and appraisal be made by a disinterested expert or the owner?
> How long will the appraisal take? What will it cost?
> What records are available?
> What men should be employed—in field and in office?
> What forms are necessary for tabulating?
> What is the best way to make the actual physical count?
> What is the best method of building up unit costs?

Use of Company Employees. Taking up the detailed consideration of the various preliminary steps, in the order in which they have just been enumerated, we have first—the use of company employees on appraisal work. Many industrial managers feel that they are perfectly competent to make their own appraisals. This is a mistaken viewpoint and its existence is largely due to the fact that many managers do not take the subject of industrial appraisement seriously enough. They think, that to make an appraisal, it is only necessary to count the various machines and items of equipment in the plant and then to price out the inventory as thus obtained with a sort of "hit or miss" set of unit costs. The industrial manager who understands the real significance of appraisal work would no more think of making his own appraisal than he would think of attempting to do the architectural work for a new group of buildings.

Appraisal work has become highly specialized and it is but natural that men who devote all of their time to the solution of appraisal problems should be better qualified to produce satisfactory results than men who are only occasionally confronted with an appraisal task. The answer to this first question is unqualifiedly, *Do not attempt to do your own appraisal work; call in a competent expert.*

With a competent appraisal expert in charge, it may be possible to utilize company employees in the task of taking inventory and thereby effect an appreciable saving in the cost of appraisement. If such a plan is adopted, care should be taken to select only employees who can be spared from plant operation long enough to give their undivided attention to the appraisal problem. If a man spends part of his time on operating work and part of his time on the work of inventorying and appraising a large industrial plant, he is apt to slight the auxiliary appraisal work in favor of the permanent job—in which he is naturally more interested. The best results can therefore be obtained only by selecting a squad of men who can be spared from plant operation, during the term of the appraisal, and turning these men over to the appraisal engineer with the instructions that they are to follow his directions implicitly until the task is completed.

Cost of Appraisement. When confronted with a specific appraisement problem, the industrial manager will find it to his advantage to call in an appraisal engineer and ask him to make an approximate estimate of the cost. Estimates of this nature are usually furnished gratis and they can be made more rapidly, and more accurately, by an experienced appraiser than by one who, through his ignorance of the actual operations involved in making an appraisal, may entirely overlook some of the more important elements of expense. The appraisal engineer will probably devote a day, or perhaps more, to a preliminary inspection of the plant and in so doing he will thoroughly familiarize himself not only with the nature of the equipment, but also with the geographical layout of the property.

One of the most important factors to be taken into consideration in this preliminary inspection is the purpose of the appraisal. If the appraisal is to be used for insurance purposes it may be necessary to adopt a more complicated scheme of tabulation than would be required if the appraisal is to be used only for purposes of accounting or for purposes of financing.

Plant Records.

Many industrial companies have in their possession reasonably accurate inventories of machinery and equipment. Any records of this kind should be turned over to the appraisal engineer as they will undoubtedly be of material assistance to him and may enable him to effect an appreciable saving in the cost of appraisement. It has been repeatedly demonstrated that men employed in the work of inventorying a large plant can work much faster checking previously prepared lists than if they are obliged to make an entire new inventory.

Field Inspectors and Office Help

It is interesting to note that the type of men which may be employed in industrial appraisal work differs radically from the type that conservative industrial managers usually employ for their operating forces. Many men who lack the staying qualities to warrant their employment as operators in an industrial plant afford excellent appraisal material. Appraisal work usually necessitates close application for a rather limited period of time. The work is interesting and the writer, in his experience in the public utility appraisal field, has found that excellent results may often be obtained by encouraging a spirit of competition.

The industrial manager who has had experience in the selection of employees will realize that the type of men who are capable of doing work of this sort do not always make good operating material. Men who are capable of close application, and of bursts of speed under the stimulus of an exciting task, are often absolute failures under the more stringent requirements of modern industrial life. It is therefore suggested that if the reader be an industrial manager, and if he is confronted with an appraisal problem, that he keep these facts in mind in selecting field inspectors. In a recent industrial appraisement the writer astonished the management by choosing men who had maintained a very unsatisfactory record as plant operators. These men, however, were thoroughly familiar with the equipment of the plant under appraisement, they were intelligent and they were of that temperamental type that can be instilled with a large degree of enthusiasm for a limited period of time.

As to office help: In most industrial appraisals the work of tabulating the mass of data accumulated in the inventory process is done in the office of the appraisal engineer who has charge of the valuation. Occasionally, however, it may happen that the company whose plant is under appraisement may wish to supply the necessary clerical force to tabulate the appraisal data. If the reader is confronted with a problem of this kind the writer would suggest that men be selected who are accurate and speedy. It is not necessary that these men should have a detailed knowledge of plant equipment.

Appraisal Forms

Obviously the work of industrial appraisement may be appreciably expedited by providing proper forms for recording the inventory data. It is out of the question to cover this phase of the subject specifically in the space accorded to this article. Suffice it to say that the appraisal engineer should carefully review the peculiar requirements of the plant under appraisement and design forms adequate to facilitate the recording of the inventory data. A little time and thought given to this phase of the problem may not only effect an appreciable saving in the cost of the appraisal but may also obviate the necessity of subsequently re-inventorying portions of the plant. In considering this phase of the subject there is just one thought to be kept in mind—record sufficient data to facilitate the subsequent identification of any machine, or item of equipment, but do not befog the issue by giving superfluous detail.

Suggestions for Inventory

The inventory of a large industrial plant may prove an expensive and costly operation unless the work is planned most carefully before hand. A method adopted by the writer in several recent appraisals has proved most satisfactory, and is suggested as a guide. Most plants are divided into numerous departments. Usually, each department has a foreman in charge. The engineer in charge of the appraisal should make it a point to see each foreman and explain to him briefly the object of the appraisal and the approximate time at which the field inspectors may be expected to arrive in his department. The foreman can then instruct the operators to so arrange their tools that they will be readily accessible for inspection by the appraiser. In this way the appraiser can make the round of the equipment of each department in a comparatively short time and with a minimum of interference to the operators of the individual machines. Of course, all tools that are drawn from the tool-room should be omitted at this stage of the appraisal, otherwise they are likely to be duplicated in the process of inventorying the equipment of the tool room.

All machinery and equipment of appreciable value should be inventoried in considerable detail. Auxiliary tools such as jigs and fixtures, cutting tools, etc., may be inventoried by more approximate methods.

Belting, shafting and machinery, which cannot be readily identified while the plant is operating, should be inspected at night, on Sundays, holidays, or whenever the plant is shut down.

Unit Costs.

No matter how carefully an inventory may be taken, it is of little value unless the unit costs, used in its appraisement, are carefully determined and represent a fair value of the equipment involved. As suggested, in the article published in the November issue of Industrial Management, there are many items to be included in the unit cost beside the actual price paid for machinery and equipment. Take, for instance, the case of a boring mill. The unit cost, as used in appraisement, should include not only the cost of the mill as purchased from the manufacturer, but also the freight and cartage charges involved in the delivery of the mill to the point of use and the costs of preparing the necessary foundations and of installing it as an operating unit of plant. All of these costs should be determined with the utmost care and their derivation should be predicated upon a prior consideration of the material and labor market for a period of several years antidating the appraisal and upon an equally careful consideration of the possible future trend of both material and labor costs. In other words, reproduction cost does not mean cost at the identical moment of appraisement. It means a fair value, on a reproduction basis, at the time of appraisement, and the determination of such a fair value should be predicated upon a careful consideration of all of the factors which may tend to produce abnormal conditions at the appraisal date.

OTHER ELEMENTS OF REPRODUCTION COST

The preparation of the inventory and determination of the unit costs by no means completes the appraisal of the physical property of an industrial concern. There are many elements of expense involved in building an industrial plant which, for reasons which will be obvious from the subsequent discussion, cannot be included in the unit costs. If the reader imagines himself in the position of an industrial promotor about to undertake the construction of a large property, he will readily appreciate the importance of this group of costs and he will realize that they are just as much a part of the total cost of producing the plant as are the actual expenditures for material and labor.

Let us assume that the construction of a new plant for the manufacture of motorcycles has been proposed. First comes the conception of the idea. Some practical man engaged in the manufacture of motorcycles sees the opportunity for placing a new machine on the market. It may be that he has devised, what seems to him, a superior type of machine or that he has evolved some method of manufacture more economical than those already in vogue. First, he will cast about for ways and means for raising the necessary capital to promote the scheme. If he is successful in obtaining financial backing, he will retain engineers and architects to make tentative estimates of the cost of constructing a suitable plant. The consideration of the engineers' and architests' reports will probably necessitate a number of conferences and will involve an appreciable expenditure of time and money.

After the preliminary steps have been completed—if the project still seems feasible—the promoter will retain the architects and engineers to prepare detailed plans for building the plant and installing the necessary machinery. Up to this time no tangible property has been created and yet appreciable expenditures have been incurred—and these expenditures are just as much a part of the total cost of constructing the property as are the funds subsequently invested in machinery, etc.

Later on, while the plant is in process of construction, engineering, tax, insurance and interest charges will accrue, and all of the expenditures involved in these items must be considered as a part of the total cost.

Obviously, an engineer in making an appraisal will find no index of these preliminary costs in the inventory of the tangible property and unless he makes a careful study of this phase of it his appraisal will fall short of representing the real value of the property.

Some of the preliminary expenses are so closely allied to the value of the purely physical property as to warrant their inclusion with the reproduction cost obtained by appraising the inventory under the caption "Direct Construction Costs." Others, while a little farther removed from the cost of the inventoriable property, are nevertheless part and parcel of the cost of creating the physical property and are usually grouped together under the caption "Collateral Construction Costs."

OMISSIONS AND CONTINGENCIES.

Experience has proven that no matter how careful an inventory may be taken, items of appreciable worth may be omitted entirely. It has therefore become customary to add an allowance—in the form of a percentage of the reproduction cost of the inventoriable property—to cover omissions from inventory.

The preparation of the unit costs used in appraising an industrial property must necessarily be predicated upon a consideration of the data available at the date of appraisal. Obviously, these data may not, in all cases, clearly show what actually happened in constructing the property. To illustrate: It may happen that the construction of the foundations for the buildings and machinery of a certain manufacturing plant has been materially handicapped by the presence of a sub-stratum of rock, necessitating appreciable expenditures over and above those that would normally be incurred in the work of excavating. Obviously, if the plant was an old one the appraisal engineer might entirely overlook this fact in preparing his reproduction unit costs and unless some allowance is made for just such contingencies as these it is probable that his appraisal would fall short of representing the actual cost, or the reproduction cost, of the plant under consideration.

To provide for such contingencies it has therefore become customary, in industrial appraisement work, to add a monetary allowance in the form of a percentage of the reproduction cost of the inventoriable property to provide for contingencies.

PURCHASING EXPENSE DURING CONSTRUCTION

Another and a very real item of preliminary expense in the construction of a manufacturing plant is the cost of purchasing machinery and equipment. In appraisal work this cost may be estimated either on the basis of a percentage of the reproduction cost of the inventoriable property, or by preparing a detailed estimate which, in the judgment of the appraisal engineer, affords a fair index of the expenditures which would probably be incurred for purchasing the equipment found in the plant under appraisement.

TOOLS AND TOOL EXPENSE DURING CONSTRUCTION.

The cost of tools used in setting up machinery and preparing it for service, as well as the cost of maintaining these tools during the construction period, is an appreciable factor in industrial construction work. In appraising a manufacturing plant this item is usually computed on the basis of a percentage of the reproduction cost of the inventoriable property.

COLLATERAL CONSTRUCTION COSTS

It is impossible in the space assigned to this article, to enter into a detailed discussion of the various items of collateral cost. Suffice it to say, that they represent a very important element in the cost of producing, or of reproducing, an industrial property and that they are entitled to just as careful consideration in industrial appraisal work as are the values obtained by cataloging and appraising the machinery and equipment resulting from the field inventory. If the reader is especially interested in this phase of the subject and wishes to obtain more specific information as to just what the collateral costs consist of and how they may be determined in industrial appraisal work, he will find a more comprehensive treatment of the collater construction costs in the article on "Industrial Property, Collateral Costs and Intangible Values" in the issue of INDUSTRIAL MANAGEMENT for May, 1917.

CONCLUSION

It is obviously out of the question to prescribe detailed methods of inventory and appraisement that will entirely fulfill the requirements of every industrial manager. In the present article, therefore, the writer has endeavored to confine himself to the exposition of the fundamental principles of reproduction cost appraisement. This whole subject may be concentrated into one phrase. Give your entire appraisement problem just as much careful thought as you would accord to any other branch of management, and when you are confronted with a phase of the problem that is beyond you, don't try to bluff it through, but call in a specialist.

Employment and Labor Maintenance

A Special Department to Aid Employment Executives

Employment Manager and Foreman

By Roy W. Kelly

Director, Bureau of Vocational Guidance, Harvard University

ONE of the most vital of numerous difficult questions arising in organizing a new employment department is the relationship to be established between the employment manager and the foremen or heads of departments. The most effective means of attacking the situation naturally lies in the direction of enlisting the interest and support of the foremen in planning and executing the new program.

In the June number of INDUSTRIAL MANAGEMENT an account was given of a gathering of foremen called by the International Harvester Company. This is undoubtedly an excellent precedent. Other large concerns have met the situation in various ways with the same aim in view and with equally satisfactory results. In every case, experience has pointed to the soundness of the principle that hiring, discharge, promotion and similar matters cannot properly be delegated to foremen or department heads. Gradually a new definition of the functions of these executives must be evolved.

A TYPICAL EXPERIENCE

A typical experience is that of Fayette R. Plumb, Inc., of Philadelphia and St. Louis, Mo. To determine upon satisfactory policies for establishing an employment department, a conference of the company's chief officers was called. After hearing all of the usual arguments in favor of leaving the functions of hiring and discharge under control of foremen, it was decided that employees were to be selected by the new department and that no one was to leave or be discharged without the employment manager's signature.

Mr. John M. Williams, secretary of the corporation, has this to say of the successful operation of the plan:[1]

> "One of the first benefits we derived was in freeing the foremen from the daily necessity of looking over men they needed at the factory door. Under the old system, the first hour of each morning and the most critical hour from a departmental standpoint, was signalized by the absence of foremen from their departments. The new system automatically changed this, and foremen were free to supervise work in their own departments, rather than lose hours daily in interviewing applicants for work. This has worked out so well in actual practice that I question if we have in our organization today a foreman who would go back to the old method of hiring, and we unquestionably would not."

In addition to lost time, which can be more profitably spent in their own work, foremen as a class have not a broad enough viewpoint to select men dispassionately, nor have they the opportunity to select them. Quite often you will find, on account of the foremen, cliques built up within a department due to nationality, creed or secret societies. This is not always intentional, but is created because the foreman draws from his only source of supply viz.: his own friends and associates.

FOREMEN'S DUTIES

The second point to be considered in this connection is a new definition of the foreman's functions with particular attention to his dealings with employees. It too often happens that widely diverse duties, all of an exacting nature, are demanded of men who are in no way prepared to perform them. It requires little imagination to picture the mental perplexity of many a foreman promoted from a relatively simple day's routine to face a confusing array of duties: inspection of product and machinery, arranging for new equipment or repairs, caring for raw materials, fixing costs, altering rates, keeping production records, training new recruits, disciplining offenders, selecting and rating employees, meeting the constantly varying demands that come with a growing department and increased production. There are certain obvious ways of reducing the bewildering variety of these tasks.

Special instructors should plan most of the educational work. The mechanical or engineering department can be made responsible for repair and installation of machinery. Clerical work ought to be reduced to a minimum and much of it transferred to the general office. Most urgent, however, is the shifting of responsibility for hiring, promoting and discharge. Because of his extensive powers over employees, the foreman has been singled out as the object of union legislation. Many unions will not admit him to membership. The most unfortunate feature of the whole situation is the deceptive nature of the foreman's apparent despotism. Too often he is a mere tool in the hands of superiors, a buffer between the demands of labor and the commands of employers.

Recent developments in management show a strong tendency toward the crystallation of a new ideal of foremanship. It will be one of the primary duties of any firm planning a reorganization of its departments to provide means for training foremen who will fit into the new order, a type of executive who will regard his duties in a professional light, who will give sincere and intelligent thought to the question of right relationships between himself and the workers under his supervision, who will be capable of understanding something of economic, social and educational values, as well as improving mechanical operations, and speeding up production.

BE CONSIDERATE

Any employment manager who enters upon his duties with the feeling that one of his principal functions is to keep "agitators" out of the plant, is losing sight of the main issue. No amount of well intentioned and highly expensive welfare work can take the place of even a small amount of consideration for the right of those who bear the brunt of the day's work to have some voice in the planning of the task and in fixing its rewards. Success in dealing with the human factors in management depends upon the ability to discover and deal fairly with the causes for discontent. It is quite unsafe to assume that a harmonious working force can be built up through the simple expedient of barring malcontents.

Principles often neglected in organization of all kinds are those which demand that the powers and duties of every member be definitely defined and that overlapping or division of responsibility be studiously avoided.

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[1] "An Actual Account of What We have Done to Reduce Our Labor Turnover." By John M. Williams, The Annals, May, 1917, page 51.

RESPONSIBILITY AND AUTHORITY

Having placed responsibilities, every official and every workman who accepts them has a right to demand the authority necessary to discharge them promptly. This implies the principle that the decision in the great majority of cases must be subject to review and not to approval. Factory superintendents are unfortunately not the only offenders in this regard. It is surprisingly easy to find presidents, directors and superintendents of the old school who refuse to delegate authority in all sorts of petty matters and who pervert their offices by personal attention to all manner of trivialities.

Equally likely to be productive of trouble is any division of responsibility. It ought to be made wholly impossible for that pleasant diversion of politicians known as "passing the buck" to find any place in a modern industrial establishment. If certain functions are to be removed from the foreman and placed under the control of new departments, no loophole should be left for questions as to ultimate responsibilities.

It is a comparatively simple matter to point out some of the pitfalls; how best to organize the employment department is a question that must be decided largely on the basis of local conditions.

What the Bush Terminal Is Doing for Its Employees

By Daniel Bloomfield

Partner, Bloomfield and Bloomfield, Employment Management Service

ONE of the most remarkable industrial establishments within the gates of New York, an establishment which ships and receives annually about five million dollars worth of goods from its eight big piers, an organization which employs about 30,000 workers, is the Bush Terminal. Over 276 manufacturers are housed there on the principle that business carried out upon a coöperative basis means economy and efficiency. The company offers its service in the form of (1) transportation facilities, (2) power and steam for manufacturing, (3) fire protection, (4) a centralized employment bureau covering the needs of tenants, (5) an emergency hospital service, (6) a bureau of social service, (7) local delivery service and (8) mail and express facilities.

Ten mammoth loft buildings of reinforced concrete give manufacturing space covering 4,000,000 square feet. The buildings are arranged in consecutive units with railroad sidings between each pair on one side and trucking platforms on the other. All transportation facilities are included in the service to tenants. The freight of the tenants is collected, assorted, billed and forwarded by a coöperative organization thus minimizing delays and doing away with trouble, waste and expense.

Electric current for light and power is furnished at 3.3 cents per kilowatt hour—a rate about half that paid by the average manufacturer in New York. The terminal company buys current for all its tenants and gives them the benefit of a wholesale rate. Steam is likewise provided at the rate of one cent per horsepower hour. All combustible waste is salvaged and burned in scientifically stoked fires.

Insurance rates are extremely low owing to the elimination of fire hazards and the installation of modern safeguards. There is a day patrol and night patrol.

Each of the 152 buildings is well protected. The plant boasts 115,000 sprinkler heads, 317 dry valves and 1,000,000 feet of sprinkler piping. Two fire pumps, each with a capacity of 1000 gallons per minute are available for pumping from wells, from the city mains or from suction lines to New York harbor. The sprinkler mains are supplied by eleven tanks having an aggregate storage capacity of 320,000 gallons and elevated 125 feet above these mains. Three automatic connections with the city mains make a total of 20 different sources of water for the sprinklers.

HEALTH OF THE EMPLOYEES

As it is a matter of common sense that efficiency depends a good deal upon good health, a study is made of the health needs of Bush Terminal workers; and such factors as sanitary conditions, wholesome food, prompt attention to accidents and small ailments receive constant attention. The well equipped hospital even has an operating room. The staff consists of a consultant, one of the leading practitioners of the East, two resident physicians, five nurses for hospital service and a visiting nurse. In an industrial community of 30,000 it is inevitable that in spite of all precautions accidents will happen. All of these have immediate care, careful treatment and medical service in order to prevent serious results.

LUNCH AND REST ROOMS

For the women a lunch room is provided conducted on the cafeteria style and in charge of a dietician whose function it is to provide well balanced meals at the lowest cost. Food is sold without profit and frequently at a loss, so that employees find it more convenient to purchase good, warm food than to bring cold lunches with them. The management of the lunch rooms keeps its dietetic plans in the background so that there is no suggestion of uplift or experimentation. Workers know that they are getting tasty food which is clean, neatly served and reasonable in price.

Adjoining the women's lunch room is a rest room containing a piano, and adjoining this a large hall. The girls have music every day throughout the winter and a visitor looking in on them will find them enjoying dancing during the noon hour.

The lunch rooms for the men are conducted under the same plan as the women's though not provided with the extras which the women enjoy.

One of the vital factors in keeping workers contented and efficient is provision for wholesome recreation. With this in view the company has provided facilities for bowling, billiards, basket ball and various gymnasium sports in the winter, and baseball, tennis and water sports in the summer.

JOB INSURANCE AND THRIFT

It is clear to those who have given the matter attention that a worker who worries about his job cannot give the best that is in him to his employer. This is another factor that has given intelligent attention. Job insurance is provided through the medium of a central employment bureau, a loan bureau furnishes assistance in emergencies and a savings system is organized for the development of thrift.

The management in common with progressive employers believes that nothing so greatly contributes to the ability, responsibility and happiness of workers as the possession of a savings account. Although the encouragement of thrift is a very difficult matter, yet the placing of adequate and convenient facilities for saving at the very factory door has proven to be a practical stimulus. At the terminal city a good many of the workers, upon being paid their wages, convert a part of the contents of their pay envelopes into saving certificates before they leave for home, thus removing the means of temptation for immediate spending.

A splendid campaign was introduced in the form of thrift clubs in all the larger industrial plants at the terminal. These clubs are strictly employee organizations, the only participation of the employer being their coöperation with these clubs. Their official treasurer helps collect the amount of savings where this is requested. The Y. M. C. A. has been very effective in the organization and extension of these clubs.

The plan of the thrift club is as follows: A worker may become a member at any time. Any amount may be deposited each day, the deposit being made for all the members in their names at the bank of their individual choice. The amount to be deposited may be increased or decreased by making application to the club representative in writing and the money may be withdrawn without reference to any officers of the company or club. Interest is paid at the regular rate by the bank to the depositor and not to the club. In order to withdraw money the workman must get his bankbook from the representative and present it at the bank.

The plan in essence therefore is to have one man make a deposit covering individual depositors. The employee fills out and signs the club membership blank which requests the company to deduct a certain amount from his wages and deposit it each week or on a particular pay day. The club representative turns the membership blank over to the cashier of the company. On each pay day the cashier hands a company check to the club representative addressed to each bank covering the total amount to be deposited in that bank, together with a list of the depositors and the amount to be credited to them individually. The club representative takes these personally to the bank with the pass books.

The Thrift Clubs meet together, or individually, at the will of the members. They have discussions on insurance, real estate, building and loan plans and investments. The purpose of the clubs is not only to encourage the members to become savers but to help them spend wisely and invest safely.

Central Employment Bureau

Among the objects of the central employment bureau is that of finding places for unfortunate men, for weeding out the incompetent, for discouraging illegitimate employment agencies and doing away with the degrading employment gate around which the jobless are wont to congregate. This bureau attempts to keep all terminal workers always employed, and in order to do so becomes intimately acquainted with each man's capabilities, weaknesses and even his home conditions. "A good man with a clean record need never fear to be out of work where once he has established his rights." The effect then of the employment bureau is to give the employer a stabilized, reliable labor market and the employee steady employment and the security and contentment that accompanies it. It also saves for the worker the serious expense of an inopportune lay-off.

The above plan requires careful study of local conditions in order to establish a balance between the seasonal and trade requirements of industries. If one shop tenant is forced, because of shortage of materials, depression in its market or other reasons, to cut down its payroll, it may be that on that very day another firm will have occasion to increase its force.

Our Group Insurance Plan

By A. J. Schneider

Employment Manager, The Cincinnati Planer Company

On October 4, 1917, the Cincinnati Planer Company of Cincinnati, Ohio, put into effect a group insurance plan as one of the means to decrease labor turnover and increase production. The following brief description of the plan as adopted may assist some other employers.

When a proposition for employees' group insurance was first offered to us by insurance companies our immediate question was, What good is it? What will it do? The answer that we received was, it will decrease your labor turnover and at the same time will gain for you more and better production from your working force. It is too early to state positively whether or not these results will be forthcoming and in what degree. However, if our labor turnover does decrease during the coming months, we will credit group insurance with its share of the improvement.

If the results are carefully studied the value of the new plan in dollars and cents can be closely estimated. But it is a mistake to say or think that labor turnover or production are entirely controlled by any one factor. So if a satisfactory improvement in our case can be shown we shall consider that the money has been well spent. The average cost of this insurance is about $4 per employee per year (less than two cents a day). The actual premium, of course, depends upon the age and length of service of the six-hundred employees who are covered. Our belief is that the plan is sure to pay for itself; it is hard for us to anticipate that this is a losing proposition.

How the Plan Was Started

Announcement of the adoption of the plan was made to the employees through a typewritten letter sent out on the company's regular letterhead neatly set up, but plain and rather short, in order to convey the idea directly with the personal touch of the manager. It was desired to have the announcement of the plan go directly from the manager to the employees' home, thereby helping to make a good impression by using the powerful factor of home influence. Following is the text of the letter which was written in plain machine-shop English and mailed on a Friday, so that it would be received at home on Saturday, which was considered the most advantageous time as it gave the family opportunity to talk the plan over with their friends and relatives on Saturday afternoon and Sunday:

October 9, 1917.

TO THE EMPLOYEES OF THE CINCINNATI PLANER COMPANY:

We want you to feel that you would rather work for THE CINCINNATI PLANER COMPANY than anywhere else. The ideal relationship between employer and employee can only be obtained thru a long association. The fewer changes there are, the better it will be for all.

The protection and care of those depending on you is of vital concern. In the event of your death or permanent disability, some plan to continue the protection and care which you are now providing, and the problem of how this is to be done has no doubt often occurred to you.

To aid you in solving this problem of care for your dependents and as an expression of appreciation of your faithful work and loyalty to THE CINCINNATI PLANER COMPANY, we have arranged with The Travelers Insurance Company to insure your lives for an amount based on the following schedule:

Those who have been in our constant employ for three months are insured for $500, those in our constant employ for six months for $600, at the end of the first year of continuous employment you are entitled to $700 insurance and for each additional year's employment you are entitled to an increase of insurance at the amount of $100 each year until a maximum amount of $1500 has been reached.

Those who are not, as yet, by their term of service entitled to this insurance, will receive its benefits just as soon as they have completed a three months' term of continuous service. This insurance is made retroactive, meaning that you will receive credit immediately for the amount of insurance you are entitled to for past services. As the length of your service increases you will receive the increased insurance in accordance with the above plan.

This insurance has been in effect since Oct. 4th, 1917.

These benefits will be provided at the expense of THE CINCINNATI PLANER COMPANY. No deductions from wages or contributions of any kind from the employees are required. This action is voluntary on the part of THE CINCINNATI PLANER COMPANY. It constitutes no contract to any employee and confers no legal right on them. It does not change your freedom to leave nor our right as employer to dismiss any employee.

All rights or benefits cease whenever any employee leaves or is dismissed from our service. In addition to offering LIFE INSURANCE protection our contract also provides an income in case of your permanent disability whether resulting from disease or accident.

An Insurance certificate stating clearly the benefits granted to you under this arrangement will be mailed to your home as soon as we can supply the Insurance Company with the necessary information.

We hope that providing this INSURANCE will further convince you of our desire to do all we can for our employees.

With our best wishes, we remain,

Sincerely yours,
THE CINCINNATI PLANER COMPANY.
(Signed) B. B. Quillen,
Secretary and Treasurer.

An Immediate Result

In the employment department an immediate increase in the number of applications for work was noticeable. Thus it was proved beyond a doubt that the insurance plan was a good talking point for both employment manager, superintendent and foreman when hiring men.

During the discussion of the plan one feature which received considerable study was whether or not insurance should be based on wages or length of service. It was finally decided that the latter course was the simplest and most effective for several reasons. In the first place many machine shops will undoubtedly finally adopt group insurance and if it is based solely on the matter of wages there will be nothing to hold the individual employee in the shop where he is working. For as long as employees can change from one shop to another without any actual, direct, personal loss they will continue to change and shift in spite of increased wages and welfare work and all other factors. So if two shops in the same locality have insurance based on wages or income alone an employee insured, say, for $1,000 will have no incentive for remaining in one organization if by changing he can have the identical advantage in the other place. But if the insurance is based on length of service, there is an incentive to remain where a considerable amount of insurance has been accumulated through a long term of employment. Another reason urged against basing the insurance on wages is the difficulty today in figuring an employee's income because of the use of wage payment systems giving premiums, bonus and the like. And still again it is possible that dissatisfaction will be created among employees if policy comparisons were made and John found that Bill was making more money "cause his insurance is bigger."

The office work required in connection with operating this insurance plan is very simple and requires but little time, say in our case about two hours per week. A card is filled out at the outset giving a complete record of each employee, stating the date of his birth, his address, his beneficiary and the name of his company. After this work has been done nothing further is required unless an employee leaves the shop or dies, except the checking of invoices and reports.

How to Get Help

By N. D. Hubbell

With the General Railway Signal Company

THE problem of getting help is one which, at the present time, is confronting employment men with a seriousness never before felt. With the "Back to the Farm" movement in full swing and all branches of our military service demanding for industrial purposes, a large quota of the very men who represent the cream of the labor market, we are all finding it difficult to fill the gaps in our depleted ranks. This applies to all concerns regardless of size or nature of work. Add to this the fact that most concerns are carrying extra burdens of production on account of the war and it will be evident why the demand is above and the supply below normal. It is especially difficult to replace skilled men because of the uncertain quality of the supply. Breaking in so many new employees throws an extra burden on all departments and this in turn must be met by more overhead expense and additional employees to keep production up to requirements.

Where will we get this help? This is the question we are now facing. We say put girls and women on jobs formerly held by men, but this is only begging the question. Girls are scarce as it is and we must develop sources capable of supplying female as well as male employees. More girls and women will be coming forward as time goes on, some because of patriotic motives, but more for economic reasons. Brothers, sons, husbands, and even fathers, who have been the wage earners are being called to serve their country and girls and women who have never been employed before will have to go into industrial life to make the income of the home meet the demands made upon it. But the demand for girls now exceeds the supply and the gap will widen as time goes on. Part of the problem will be met by labor-saving devices and improved methods of production, but this will take time and even then solve only part of it.

Thus it is that in the last analysis a large share of the burden will fall upon the factory employment department, which will necessarily come to the front with increased facilities for getting new employees, placing them to best advantage and holding them once they are on the payroll. In the following are outlined several suggested methods for getting help which have been used with varying success. They are not suggested as a revelation of trade secrets, but as a brief summary of some of the possible methods now in use, which may be of help to other employment men in the present situation.

Hiring from the Shelf

The subject of getting help naturally brings up the question of keeping applications on file or "Hiring from the Shelf" as it is very often called. Some concerns do not keep on file applications from any people whom they cannot place at the time they apply, while others hire only from the shelf list. Both have reasons which seem to justify their stands, but these opposite arguments only point out clearly that both schemes are practicable and that a combination of them both can be used to good advantage. Under present conditions it cannot be assumed that an application on file will be good for very long, unless the reputation of your concern is so good that workmen will leave other jobs to come to work for you.

For ordinary unskilled or semi-skilled work an application will not be good for more than a few days at the most, unless there is some particular reason why the applicant wants to work in your plant, such as convenient location, personal ties, or an especially desirable class of work. For highly skilled jobs the applications will probably be good for a longer time. Although a skilled workman will not be out of a job long under ordinary conditions, there is always a chance of your being able to offer him work more to his liking, especially, if he has taken the first good job available to tide him over until he can locate just what he wants. Then again, there is the man who is working but wants to better himself, the code of ethics covering such cases will vary but there is really no plan or agreement which is practicable for preventing changes for this reason.

Reasons for the Application File

1. Workmen expect it. As a general rule good workmen expect the privilege of filing an application because they realize that it will probably save them several fruitless trips. They can telephone in and the employment man having the cards to refer to knows about what they are fitted for.

2. It makes it unnecessary to depend entirely upon men who happen in at the office. Although a large percentage of those hired come from this class it is a very uncertain quantity, the right man is generally not there when wanted.

3. It is poor business to lose track of an especially desirable man who happens to apply at a time when he cannot be placed. Once the man has left the office he is lost forever, unless you have his name and address.

4. An application file provided a reasonable number are sent for will raise the standard of the applicants because good workmen will not feel that they have entirely wasted the time spent in coming in, even, if they are not hired the first time they call.

5. Hiring from the shelf will, in the last analysis, reduce turnovers, instead of increasing it as is often claimed. Instead of filling positions with floaters who just happen in, they are filled with reliable workmen whose records have been verified.

6. The expense of forms and clerical labor involved is small compared with the cost of extra scouting and advertising made necessary by having no one in mind for openings as they occur.

7. At least part of the applicants sent for will come in. Even with the labor market as tight as it is now, a good percentage of those sent for will reply, provided care is used in selecting those sent for. Even if the applicant is working and does not care to change he has a better opinion of the firm sending for him. This feeling of good will towards a concern by workmen is a vital factor and should be developed.

Granting then as most concerns do, that a shelf file of applications is desirable, this does not solve the problem of getting help.

Sources of Employees

1. Those who happen to call looking for work. This source, although it supplies the bulk of new employees is an uncertain quantity, and the applicants require a great deal of weeding out. The majority of them do not represent the best class of labor, especially for skilled work. Good men will not keep coming back because they will not be long out of work. It should be the aim to raise the standard of this class by encouraging good workmen to return and tactfully tending to discourage those not desirable. The higher the standard of this class is raised, the more efficient will be the employment department, because most of these applicants are out of work when they apply and can be used to good advantage to fill positions in a hurry.

2. Those recommended by a third person who is interested, but who has no definite opening in mind. It is very advantageous, if not essential, for the employment man to have a group of friends who are referring to him good men who are out of work. In most cases they are familiar with the man's past record and can give some valuable information concerning him. Such sources must be educated as to the class of men acceptable, and also encouraged by having as many as possible of these applicants hired. These applicants naturally fall into two classes:

(a) Those recommended by friends outside of the organization. This will include especially business and professional men who are coming in contact with workmen. They can be encouraged to call up regarding good workmen whom they happen to know are out of work. If there is a possibility of using the man, he can be sent in for an interview. This takes very little time, costs nothing and in many cases supplies good men who will "stick" because of the personal interest taken in them.

(b) Those recommended by employees. These applicants when once satisfactorily placed make the best employees. They are more liable to stay and to make good. They will have friends in the organization to introduce them, show them around, make them feel at home, and encourage them during the first few days which are the hardest. They will also feel under obligation to make good for the sake of those who recommend them. In order to have this work out successfully, however, it is necessary to make an employee feel at the time he recommends an applicant that he is to a certain extent assuming the responsibility for the man's being desirable as an employee from the standpoint of character, ability, steadiness, and honesty. This can best be accomplished by having employees come to the employment office and talk over with the employment manager the cases of good men whom they know are available. If it then seems advisable to have the man come in for an interview the employee should be given a form to fill out and sign. This slip, when presented by the applicant, will serve as an introduction to the employment manager. The employee recommending an applicant should be informed if he does not come up to expectations.

3. Those obtained by scouting. By scouting is meant any means of still hunt for applicants to fill specific openings. This is the real test of an employment man. He must, of course, be able to organize and conduct a department and competently select but, if he cannot get help when he needs it, he will not be of much use on the employment job. There are many sources which come under this class. The principal ones are:

(a) These met in past experience. Every employment man, especially if he has been in more than one plant, has come in contact with good workmen either in the shops or outside. In many cases he knows of just the man he wants for the specific opening, although he may never have filed an application. This also includes men who have worked for the concern before but who left good records, and would be willing to come back; exceptionally good workmen who applied at a time when they could not be placed would also come under this class. These men will naturally be reached by telephone, messenger, letter, personal visit, or by sending word to them by a workman who happens to know them. Names obtained in this way can be kept either in a personal note book or in the application file.

(b) Those obtained through employees. As previously pointed out these applicants make very desirable employees. It is very often possible to get men for specific openings by letting employees know what jobs are open. In many cases it is practicable to use a bulletin board near the factory entrance showing a list of jobs open, requesting employees to speak to the employment manager about suitable applicants, whom they know to be available. Where the concern publishes a company paper or house organ for circulation among employees, it can be used to advantage to bring employees and the employment department together on this method of obtaining help. Care must be used in turning down applicants recommended by employees in order to create no hard feelings. This is largely a matter of educating them as to the class of applicants acceptable.

(c) Those obtained through employment bureaus. As a general rule it is not very satisfactory to take applicants from private agencies charging a fee. From the applicant's standpoint he has bought a job and this obviously is undesirable. There are, however, many agencies charging no fee which are getting a very good class of help. No effort is made to give the relative merits of these various agencies, the principal ones are enumerated with the class of labor they supply.

Editorials and Comment

The Great War and The Work Ahead

THE anarchy and revolution which have broken loose in Russia give us a forecast of what must inevit-happen throughout all the countries now dominated by Germany. Released from the death-dealing rule of military law, the ignorant and helpless peasants of Russia, by tens of thousands, have simply thrown down their arms and refuse to longer face the carnage, death and unspeakable brutalities of this accursed war. Precisely the same thing would now be happening throughout Austria, Hungary, Bulgaria and all the Balkans, but for the "blood and iron" of German military rule—but for the fact that the wretched soldiers continue to fight because, upon penalty of death, they are forced to fight.

Germany is now financing, feeding, equipping and actually leading all the armies of her dependent allies. How much longer her failing resources will enable her to withstand that awful strain—and meanwhile suppress the uprisings of millions of people who detest her brutal rule—is simply a question of time. The high seas are tightly closed to her; the submarine ruthlessness is steadily failing in effectiveness; the neutral countries bordering the sea—Holland, Norway, Sweden and Denmark—are now closely rationed to their own needs; America, with all her boundless resources in men, money, materials and destructive inventions, has joined the cause of the Allies with exalted confidence and enthusiasm; every passing month brings us a steady, rapid, and enormous increase in the number of trained soldiers, as well as in all the materials, implements and munitions of modern warfare; and, finally, the collapse of the Russian armies and the surprising German victories in northern Italy—evidently planned as a dramatic surprise—have united the Allies as never before and given us positive assurance of the harmonious coöperation of all our armed forces, on land and sea, under the command of a single military authority.

In brief, the French turned the Kaiser's terrible war machine at the Marne; again at Verdun the heroic Gauls said, "They shall not pass"; at Cambrai the British have given them a foretaste of offensive warfare with newly-devised machines of destruction like the "tank"; and when America's armies and *whole fleets of airplanes* get into the game, we can easily foresee the inevitable result.

Now for a little history!

* * *

Napoleon Bonaparte was incomparably the greatest soldier of all modern times. He over-ran Europe like a firebrand, made pawns of the puppet Kings then ruling on the Continent, dethroning many of them to make places for his kinsmen and favorite Marshalls, and to this far day his fame shines resplendent as the only world conqueror fit to be classed with Charlemagne, Caesar and Alexander. But Napoleon overreached himself, and he met his fate at Waterloo because all Europe, including "the tight little British Isles," combined to suppress him as a menace to the expanding civilization of a century ago—precisely as the enlightened nations of the earth have now combined to suppress the Kaiser! And it was toward the close of his career, a year before St. Helena, that Napoleon left this prophetic message for mankind, under date of January 1st, 1814, viz:

> I am willing to confess that I have made too many wars; I had far-reaching schemes. I ventured to secure for France the lordship of the world. I deceived myself: these plans were not consistent with the size of our population. I had to bring them all under arms, and I must admit that the limit of social conditions, and the softening of manners, does not allow me to ask a whole nation to take up arms. If I must suffer for the misfortune of having miscalculated my own chances, I will suffer for it. I will conclude peace in such a way as circumstances command, and this peace shall not be more humiliating for any one than for myself. I have been deceived; I ought to suffer, and not France: it has made no mistakes, it has shed its blood for me; it has refused no sacrifice. As for myself, I only ask for the honor of showing a very difficult courage, the courage of renouncing the greatest ambitions which have ever existed, and of sacrificing for the good of my people magnificent plans which could only be carried out by exertions which I will no longer demand.

Great soldier and great law-giver that he proved himself to be, it was no less a personage than Napoleon himself who predicted that "all Europe will be either republican or Cossack." We may now be sure that it can never be Cossack, because trench warfare, the machine gun, the motor car, the motor cycle, the "tank" and the airplane have simply put the Cossack cavalry out of business. And we may be equally sure that every part of the civilized world is now certain to become republican or representative in its political institutions, because the Armageddon has narrowed itself down to the simple issue of autocracy *versus* democracy the rule of the German Kaiser, or the rule of the people!

This is the thought that animates the breast of every soldier in the ranks of all the Allies, and since the statesmen and leaders of France, England and Italy are rivaling the President of the great American Republic in daily protestations of devotion to the rights of small nations, or "home rule," we may now be entirely sure that, in Lincoln's immortal words, "Government of the people, by the people and for the people shall not perish from the earth." It may take months, it may take another year, and possibly it may require yet a longer time to end the Kaiser's reign of bloodshed—but end it must, inevitably. And when it does end, then we may look for years of political unrest and grave local disturbance throughout all Europe.

Simply contemplate Russia. A vast Empire stretching clear across the European continent from the North sea to the Pacific, and from the arctic regions to the hot plains of Siberia; and this widespread territory inhabited by 180,000,000 of varied peoples, speaking many different languages, having differing customs, nearly all of them densely ignorant, and all of them wholly innocent of experience in the science and practice of government. Assuredly it is safe to predict that a generation of time must pass before we can expect to see stability and peaceful industrial development in Russia.

Then the great Austrian Empire is literally seething with political discontent and threats of dismemberment; the Balkan states have long been a hotbed of righteous and bloody protest against the misrule of the Turks, the Austrians and local potentates and tyrants; all Poland is yet to be re-established as a separate state, with no rest in prospect until the Polish patriots have their way—and what of Germany? As Mr. Redfield graphically points out in this issue, when the war is over Germany will wake up to a new world—her overseas commerce gone, her ships confiscated, many of her principal industries transplanted to America and elsewhere, all her best customers alienated, her government bounties and subsidies gone forever, and her people overburdened with debt and crushing taxation! Verily, when those bloodthirsty German soldiers get back home from the terrible trenches to face reality, and once find themselves free from old Bismarck's "blood and iron" rule, we shall see disturbances in Germany which will mean anything but peaceful industry at starvation wages because the Kaiser, the Crown Prince, the Junkers, the owners of vast landed estates, and privileged individuals generally, will be fleeing for their very lives!

In England and in Italy, also, the return of the soldiers is certain to bring about industrial disturbance of the gravest character. Nothing short of breaking-up the great landed estates of England and Italy for the benefit of small farmers—as has been done in France and Ireland after generations of warfare—can satisfy the men and women who rightly desire to own the acres which they till; and nothing short of the most drastic taxation of great estates and all large incomes and excess profits can satisfy the workers who will have votes and a voice in government, and who must share the burdensome cost of the war.

Thus we see that after hostilities have ceased, after the League to Enforce Peace becomes a fact, and after the combined navies of the Allies begin the work of patroling the high seas to preserve international order, all Europe will be so disturbed by local and political ferment—by boundary disputes, and by heated contests over forms of government, over socialism, over taxation, and especially over the land question, that years of time must elapse before stable industrial conditions can be re-established.

This means that the United States will be the one country in all the world within whose boundaries political stability and industrial peace will be secure; and hence the whole world must turn to us for all standardized and low-priced machine products, like locomotives, automobiles, motor trucks, farm tractors, farm machinery, machine tools, mining machinery, electrical machinery, typewriters, sewing machines and all the endless variety of mechanisms and materials which can be produced cheapest by automatic and semi-automatic machinery operated by intelligent, ambitious and skilled mechanics at high wages.

> "It is not the lowest, but the highest paid labor, **with scientific management and machinery,** which gives cheapest products. Some of the important staple articles made in Britain, Germany, and America, are produced cheapest in the last, with labor paid double."—Andrew Carnegie in "The Empire of Business."

In the light of this certain prospect of a long period of profitable business, I feel like extending heartiest congratulations to all our readers, with best wishes for a most generous share in the prosperity of the coming new year. For we shall undoubtedly have business in plenty, both at home and abroad; we shall have profit in plenty, for those who use foresight and judgment; and we may also be sure of industrial peace, if we simply apply common sense, conciliation and the promptings fair dealing and humanity to the adjustment of all disputes as to wages, hours, unions, open shop, closed shop, or what not.

I am also prompted to congratulate our readers over the increase in the size of the Magazine, which has been heartily commended upon every hand; over the advance in our advertising rates, which has been generously approved by all our oldest advertisers, thus positively assuring both the prosperity and perpetuity of the Magazine's creative and invaluable educational work; and I am so inspired by the wide-spread--indeed world-wide recognition which has finally come to industrial management as a distinct Science and a new Profession, that I am sure the time must soon come when we shall have to call an international Congress of the pioneers and leaders in the field of wealth-production in which the late Frederick W. Taylor proved himself the most original, the most creative, and the most constructive genius of our times.

Finally, I cannot close these felicitations without giving expression to my great personal gratification over having been joined in the work by Mr. L. P. Alford, who for many years was Editor in Chief of the *American Machinist*. Mr. Alford has been closely associated with me in the editorial conduct of the Magazine since April last, and that nine months of joint work prompts me to hope that the association may last through many years to come—not alone because of the enthusiasm which his study of the new science of management has developed, but especially because of his invaluable training for the work to be done.

Educated at the Worcester Polytechnic Institute, he was graduated in 1896, under Dr. Mendenhall; then devoted twelve years to actual machine shop and power plant work, starting as a machinist in overalls, and rising to the post of chief mechanical engineer of the Beverly plant of the United Shoe Machinery Company; in 1905 his Alma Mater conferred upon him the degree of mechanical engineer for his valuable research work into the friction losses and power consumptions of four machine shops combining about 5,000 machine tools; and then in 1907 he joined the editorial staff of the *American Machinist* under the inspiring leadership of the late John A. Hill, a man of the highest ethical ideals, who proved himself a masterful genius in the development of legitimate technical journalism. Mr. Alford's practical and professional training, therefore, eminently fit him for the editorship of a magazine which deals only in facts, which described actual practice, and which is written for, and written by, men who think, who plan, and who actually do things.

I shall, of course, continue to give the editorial policy and conduct of the Magazine my personal direction, as I have done from its first number, but Mr. Alford will be its active editor, and in that fact both our authors and our readers may feel secure in the assurance that, more than ever, it will be "The Authoritative Technical Magazine."

JOHN R. DUNLAP.

New York, Dec. 29, 1917.

Imperative—For a "Minister of Munitions"

PRACTICAL business divorces, separates, manufacturing and selling, or production and distribution. The business of war includes both production and distribution. American industry manufactures the tools for fighting. The United States military organization distributes these tools and is putting them to use to kill Germans and Austrians.

Following the practical experience of industry the manufacturing of these tools and their utilization should be under the control of two separate organizations.

But such is not the case—most unfortunately.

The Congressional investigation of the War Department has showed the country that our splendid young American men now under the colors are not provided with everything that they need to fight the nation's battles. We have been at war with Germany for nine long months.

Patience is a virtue that must not be despised.

But are we right in exercising continued patience and in excusing the situation by saying that the herculean task of providing materials of war could not have been done any better than it has been done, and that all we need to do is to continue to be patient and believe and expect that things will come out right in the end? Or should we, not impatiently but constructively, analyze the situation, place our finger upon the spot of weakness, on the imperfect link in the chain, and fearlessly point out the remedy?

INDUSTRIAL MANAGEMENT believes that the latter is the only possible way.

The functions of production and distribution are separate and distinct. Whenever they have been combined in private industry, trouble and lack of effectiveness have ensued. As now administered the great buying and producing organizations for war of the national Government are under the control of departments that are directing the prosecution of the war. Manufacturing and use are under one and the same head.

It is imperative that we should follow the practical experience of industry and the lesson taught by our great ally, Great Britain: Reorganize our method of conducting the business of war and have separate officials responsible for manufacturing and for fighting.

Once this is done the official responsible for production will face the stupendous task of coördinating all of the government requisitions in private plants and manufacturing orders in Government shops. To do this the entire manufacturing capacity of the United States without exception must be under his sole direction and control. This action must be as sweeping as the one just put into effect of placing the entire transportation facilities of the United States under the direction of the Hon. William G. McAdoo.

Thus in the second place it is imperative that we should have at the earliest possible moment a "Minister of Munitions," an United States Manager of Manufacturing.

In a democracy citizens balk at the thought of a dictator—and rightly so under ordinary conditions. But under the present extraordinary conditions of a struggle for the preservation of the national life a practical dictator of manufacturing with the widest of powers is imperative.

Help Along this Investigation

STOP for a moment and answer this personal question. How many able-bodied men have rendered you some personal service during the last twenty-four hours?

How many of these men should be engaged in doing something to make the nation strong? How much of the work that these men have done for you could be properly performed by women?

One man asked himself these questions, or their equivalent, and after reflecting wrote the following letter:

December 11, 1917.

Mr. C. E. Knoeppel,
c/o C. E. Knoeppel & Co.,
New York, N. Y.

Dear Mr. Knoeppel:

This afternoon on the Century, I have read and reread your wonderful article "American Industry Needs Women." in the December issue of "100 per cent."

And reading, I have reflected.

At lunch today, a man checked my hat, another man served my food, another man removed the dishes and still another brought my cigar.

Yet we pretend we are organized for war.

After lunch a man shaved me and another man shined my shoes—while I read a paper sold me by a man who might have been, should have been, SHOULD BE at war.

A man carried my bag to the sidewalk; another man opened the door of a man-driven taxi to take me to my train. A man opened the taxi and another man grabbed my bag; a man sold me my ticket and another man examined it. On the train TWO men took up the ticket; and a polite young man who might be, SHOULD BE, fighting, is typing this outburst to you.

Yet we pretend we are organized for war.

Shatter the pretense if you can and will. Shatter it, some one MUST—or we never can win the war.

As I am beginning to see it, Mr. Knoeppel, the fate of the nation, indeed the fate of all the world, hangs on the seventeen men who served me today: these seventeen, and seventeen hundred, seventeen thousand, seventeen million others like them.

These men must give way. They must be displaced or replaced. And those who are replaced must be, and will be replaced by WOMEN.

Men who are able and who have no dependents must FIGHT. Those of us who are less able or who have dependents must feed and clothe the fighters; and we must permit and encourage and HELP the women of the land to take up the tasks which they are anxious and ready to undertake, and for most of which they are eminently fitted.

Yours very truly,
(Signed) R. C. WADSWORTH.

Mr. C. E. Knoeppel, to whom Mr. Wadsworth's letter was addressed, has prepared a questionnaire to bring out from the best of the thinking and experience of American industrial leaders plans and methods whereby patriotic American women may be helped to undertake tasks that men must give up. This questionnaire has been sent to a number of American manufacturers. But it deserves to be widely answered by the readers of Industrial Management. These are the questions:

1. How are we going to find the immense army of women needed?

2. What basis shall we use for selecting women for industrial work?

3. What efforts shall we make to provide clean, wholesome living conditions?

4. What changes will we have to make to provide proper working conditions?

5. What social conditions will we have to provide?

6. What hours should women work and how about rest periods, fatigue and the like?

7. How will we arrange to subdivide and arrange the operations so that women can efficiently perform them?

8. How will we train women and who will do it?

9. What steps will be necessary to induce the full coöperation of:

   (a) Labor unions?
   (b) Organizations of women?
   (c) Our government?

10. What steps should be taken to change and unify the state laws with reference to women labor?

11. How shall we adjust and arrange the wages of women?

12. What will we do with reference to women labor after the war?

Each reader is earnestly invited to consider this questionnaire as personally addressed to him, and is requested to make an immediate reply to the editors of this magazine, and thereby assist in formulating answers to the queries with the sole purpose of helping American industry.

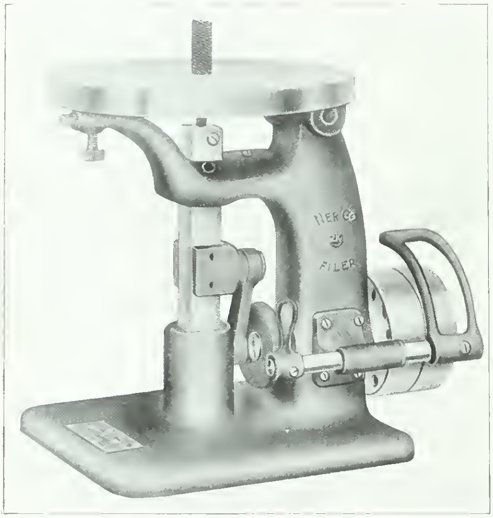
Please help.

Factory Equipment News

The Latest Labor-Saving Machinery

The Nerco Filing Machine

THE Filing Machine illustrated herewith, marketed under the trade name "Nerco," has a platen 8 inches in diameter, a bench height of 10 inches, overall width of 8 inches, and an overall length of 12 inches. Its construction is so readily seen in the illustration that no detailed description is necessary. However, one feature is the square shaft supported by long babbitt bearings, intending to do away with side motion and the tendency to under-cut when filing to finish lines.



NERCO FILING MACHINE

It is made by the Newark Engineering & Refrigerating Co., Newark, N. J.

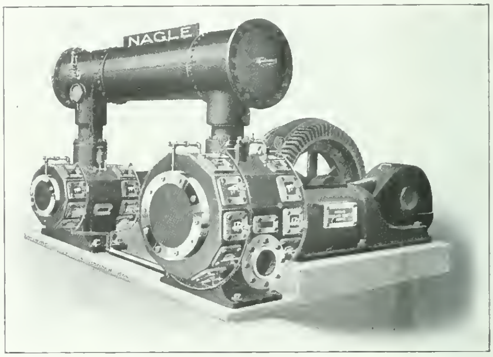
Duplex Air Compressor

THE air compressor illustrated herewith is known as class Y-C-E. Its general construction follows the standard practice of the builder, the Nagle Corliss Engine Works, Erie, Penn.

The frame is massive to live up to the requirements of twenty-four hour service. The main bearings are provided with a constant supply of oil under a system of flood lubrication. The quarter boxes, with large bearing surfaces and fitted with wedges adjusted by means of lifting screws, rest on planed surfaces in the bearing jaws and are held down by heavy cap. The bearing shells may be removed by lifting the shaft sufficiently to remove the pressure, then turning them up around the shaft, the cap being previously removed.

The air pistons are of the boxed form; the piston rods are made from open hearth steel forgings, machined and polished. The connecting rods are forged from special open hearth steel, both crank-pin end and crosshead-pin end are solid. The crosshead-pin boxes are of plastic bronze while the crank-pin boxes are lined with genuine babbit.

The crosshead is of semi-steel, fitted both top and bottom with adjustable shoes. The intercooler consists of a shell containing a nest of brass tubes through which cooling water circulates. By removing the bolts at the fixed end the entire nest of tubes may be removed for inspection. The air cylinders are cast from a special heat of close-grained iron. Both inlet and discharge valves are "Airlite" flat-disc type set radially in the cylinder barrel.



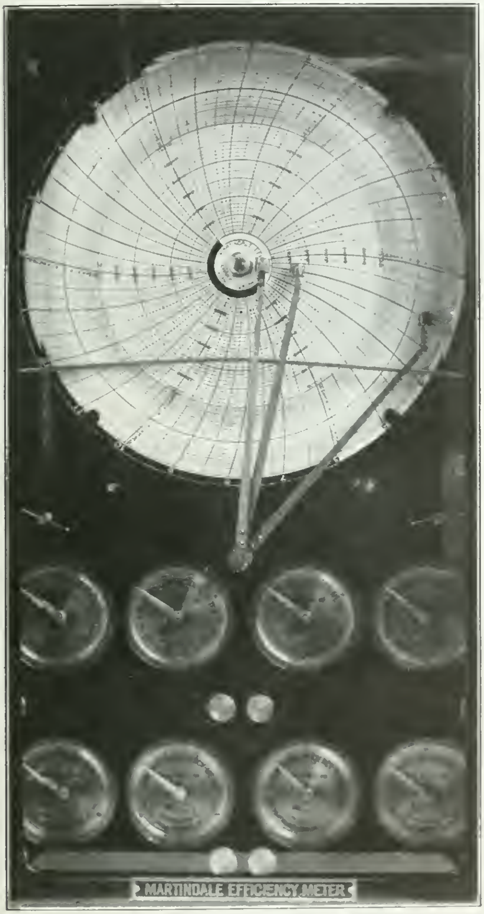
NAGLE DUPLEX AIR COMPRESSOR

The crankshaft is turned and finished from a single, straight, open-hearth forging. It is increased in diameter in the center to allow for the key-way for the rotor and the exciter pulley. Oil is carried at a sufficient height to allow a slight submergence of the crank disc. The air cylinders are provided with sight-feed lubricators.

An Efficiency Meter

A RECORDING instrument known as the Martindale efficiency meter is shown in the accompanying illustration, page 75. It is arranged to perform the operation of addition, subtraction, multiplication and division, being operated by electrical impulses which may be derived from reciprocating or revolving machinery or from any kind of automatic action that can be controlled and registered.

The instrument illustrated is provided with eight graduated dials which are the indexes of a corresponding number of adjustable escapements to each of which is attached an individual electrical receiving device. Four of these receiving devices are attached to a totaling mechanism which operates the inner or "input" pen. Likewise four are attached to a similar mechanism which operates the middle or "output" pen. The pointers on the dial may be set to any desired number by means of the knurled thumb screw below and at one side of each dial. The instrument is so arranged that when any number of these receiving devices receives an electrical impulse, an amount, equal to the amounts at which the pointers on the energized receivers are set, is instantly recorded by the proper recording pen either as input or output on both. Simultaneously with the totaling and recording of these results the instrument continuously divides the indicated total output by the indicated input and records the result by means of the outer or efficiency pen.



MARTINDALE EFFICIENCY METER

On reciprocating and revolving machinery and quantity indicating instruments a simple electric contact and wiring is all that is required to convey the electric impulse to the meter.

The illustration also shows a record from a meter installed in a power plant showing the amount of coal burned, the amount of water evaporated and the amount of water evaporated per pound of coal.

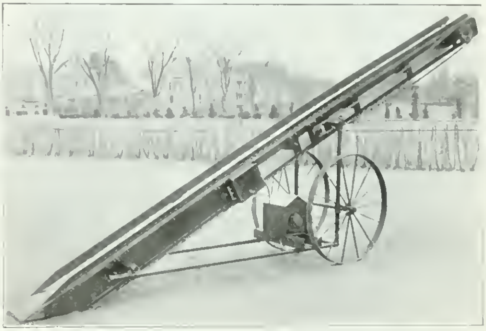
It is possible to use the efficiency records in five distinct ways: 1. To indicate directly the efficiency or inefficiency of an operation; 2. To indicate the operator who is responsible for the condition of inefficiency; 3. To indicate the most efficient grade of input; 4. To attach these meters to different types of equipment using the same kind of flow or other output and compare records which indicate the most efficient type of equipment to use for the grade of input tested; 5. To obtain capacity by studying total input and total output.

This meter is placed on the market by The Martindale Company, Bay City, Mich.

Portable Scoop Conveyor

THE scoop conveyor shown herewith has been developed to provide a portable machine that can be readily handled by one man for the purpose of loading, unloading, stacking and reclaiming loose materials such as coal, coke, ashes, crushed stone, sand, gravel and the like. It may also be used to handle sacks, packages, boxes and manufactured articles within its range. It has a rating capacity of one ton in one and on-half minutes.

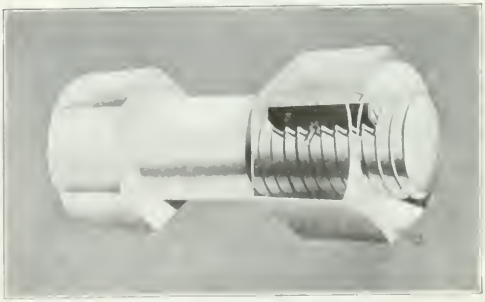
The machine is operated either by an electric motor or gasoline engine and is known as the "scoop conveyor" because the conveying belt receives its material through a scoop which can be pushed or completely buried into the material that is being conveyed. This machine is built by the Portable Machinery Company, Inc., Passaic, N. J.



PORTABLE SCOOP CONVEYOR

Patterson Lock Nut

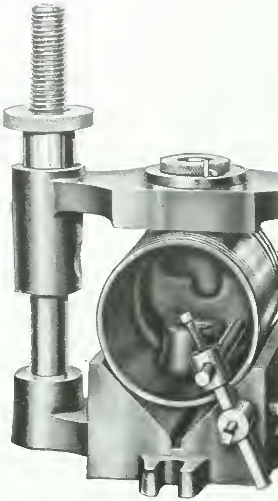
THE accompanying illustration shows a lock nut manufactured by the Patterson Lock Nut Mfg. Co., Chicago, Ill. The construction needs no detailed description. The theory upon which the nut has been constructed is, that if a nut can be kept from starting to turn back on its bolt, it will always remain tight. Thus, the construction of this lock nut is such that it is intended to always be held in close contact with the surface against which it is tightened.



PATTERSON LOCK NUT

Piston Boring Jig

FOR the operation of crossboring and reaming pistons for the insertion of the wristpin, the B. L. Schmidt Co., Davenport, Iowa, has recently placed on the market the jig shown in the accompanying illustration. It consists of a V-block, to which are attached two uprights serving as guides for the sliding yoke that carries the guide bushings.

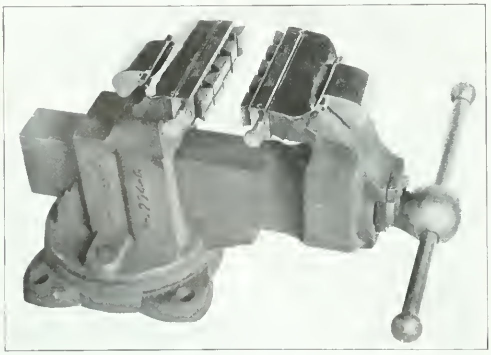


SCHMIDT CO.'S PISTON BORING JIG

The upper ends of these two uprights are threaded and are provided with knurled clamping nuts. A gage is attached to one end of the V-block for setting the piston. It is also provided with two lugs or ears for clamping to the machine table. The device can be fitted with any desired size of slip bushings, and is adjustable to all sizes of pistons up to a diameter of six inches, as this is the distance between the uprights.

Equalizing Vise Jaw

AN equalizing vise jaw, comprising a flexible steel surface that can accommodate itself to irregular surfaces, because of its form, which has numerous points of contact, and bear upon each with the same amount of pressure, is shown in the illustration. It is known as the universal equalizing vise jaw, and is placed on the market by the Universal Equalizer Co., Cincinnati, Ohio.

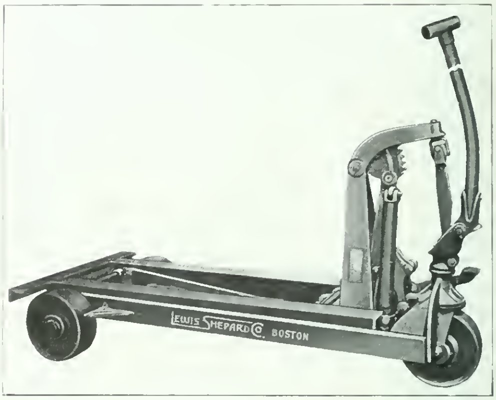


EQUALIZING VISE JAW

It is intended for general machine shop use, where it is necessary to grip pieces of irregular shape or uneven or lumpy castings.

"Jacklift" Master Truck

THE accompanying illustration shows a new, type L, jacklift truck designed for a carrying capacity of 2,500 pounds. It possesses the same features of construction as other types made by the firm, Lewis Shepard Co., Boston, Mass.

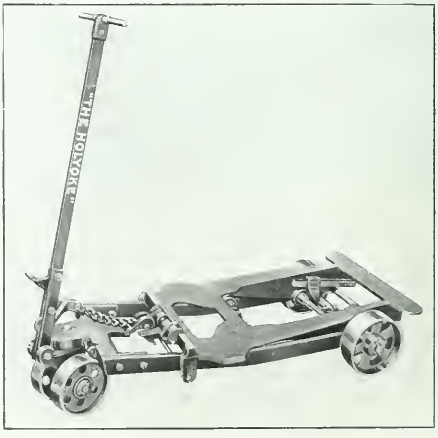


"JACKLIFT" MASTER TRUCK

All of the castings in this truck are either of malleable iron or crucible steel, with the exception of the wheels. The type is made in six models, three having wheels six inches in diameter and the others ten inches in diameter. The lifting ratio in each model is forty to one.

Holyoke Transfer Truck

THE Holyoke Truck Company of Holyoke, Massachusetts, has just put on the market a 5000-pound truck designated as model RL10. In design it follows the details of other trucks made by this firm. The extreme length of the handle raised is 60 inches; length of



HOLYOKE MODEL RL-10 TRUCK

truck platform 40 inches; extreme width of truck 27 inches; height of platform when lowered 10 inches; height of platform when raised 12 inches; front wheels are 8¼ x 2¼ inches; rear wheels 10 x 3½ inches; wheel base 48 inches; size of platforms that can be accommodated 33 x 32 inches to 52 x 40 inches.

Drum Reverse Switch

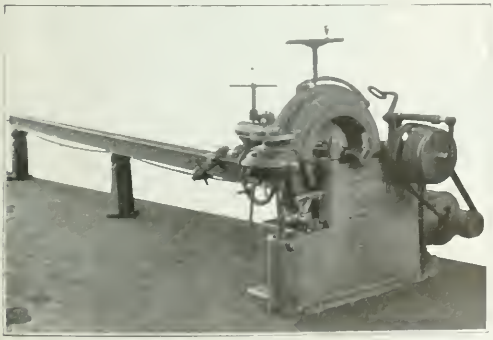
ONE of the latest products of the Westinghouse Electric and Manufacturing Company is a small, drum, reverse switch (Type 810) for operating motors in machine-tool, wood-working machines and other installations where reversal is necessary. The small size of the switch makes it especially adapted for mounting directly on the machines.

DRUM REVERSE SWITCH (TYPE 810)

The back of the switch is formed of a terminal board of micarta having on its front the stationary contacts. The movable contacts are mounted on brass brackets clamped to the shafts from which they are, of course, insulated. Contact is insured by means of phosphor-bronze springs. All live parts are enclosed in a sheet steel cover lined with asbestos and held by latches to permit of easy removal. These switches are made for both direct and alternating current circuits.

Heavy Duty Cutting Off Machine

THE heavy duty cutting off machine illustrated herewith is designed to handle the following sizes: Rounds from 1 to 4½ inches; squares from 1 to 3¼ inches, and any other size or shape that can be contained within a 4½ inch circle. The general features of design are those that have been developed and standardized by the maker, The George Gorton Machine Co., of Racine, Wisconsin.



HEAVY DUTY CUTTING OFF MACHINE

The automatic power feed mechanism is of a new type, designed to obviate the necessity for reversing clutches when the operator is ready to raise the cutterhead after finishing a cut. The main gear and pinion bearings, as well as the drum bearing run in oil. The working parts and ball bearings of the feed mechanism are submerged in oil. Thus, the only bearings that lubricate by grease cups are those of the pump.

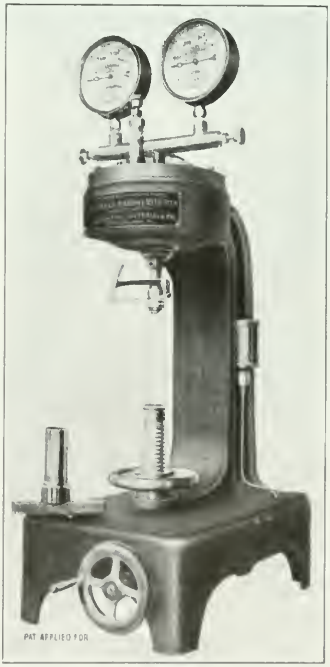
The machine is designed for either belt or motor drive. If the latter is desired a 3-h.p.-d.c. variable speed motor of 900-1800 r.p.m. is recommended. If a constant speed motor must be applied any speed between 1500 and 1800 r.p.m. is suitable.

A special cutter grinder is furnished with each machine to take care of the cutter blades. This grinder is equipped with a grinding wheel and fixture for grinding both round and wide nosed cutters.

Additional equipment that can be supplied is a stock rack and a bar support.

Hardness Testing Machine

A BRINNELL hardness testing machine, known as the "Improved American Model," has been designed and recently placed on the market by the Scientific Materials Co., Pittsburgh, Pa.



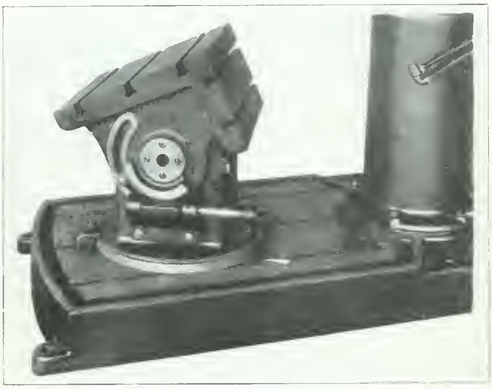
BRINNELL HARDNESS TESTING MACHINE

The illustration shows its construction, which is a familiar C shaped frame carrying an adjustable anvil at the bottom and a cylinder and piston with the necessary registering apparatus at the top. Of the two pressure gages shown, one is intended for regular use and the other for use as a test or check gage. The automatic leveling gage permits the handling of irregular shaped pieces up to 12 inches in size. Pressure is applied by turning the hand wheel, permitting a finely regulated decrease or increase. The hydraulic liquid used is glycerine.

An attachment that is a feature of this machine is the depth measuring gage. This magnifies the distance the ball penetrates 50 to 1. The scale is graduated in hundredths of a millimeter, and the total scale of 150 divisions represents an indentation of 1½ millimeters.

Universal Tilting Table

THE universal tilting table for use on radial drilling machines is a recent product of the Morris Machine Tool Company, Cincinnati, Ohio.



MORRIS UNIVERSAL TILTING TABLE

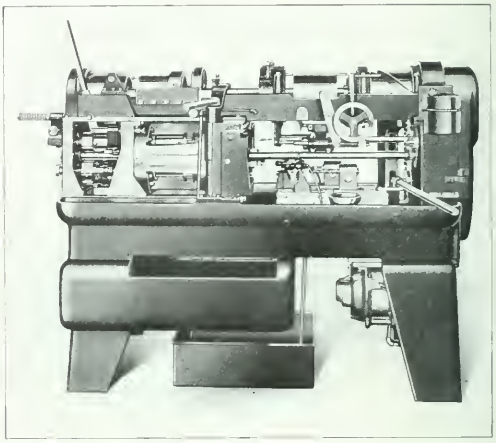
By means of a worm and worm wheel segment this table can be tilted to any desired angle. Furthermore, the table can be swiveled around and clamped in any position. When returned to its normal straight position it rests on positive stops.

The upper working surface is 18 x 18 inches in size, and the side surface is 11 x 18 inches, each has ¾-inch T-slots.

Cone Four-Spindle Automatic

THE illustration shows a new four-spindle automatic screw machine recently placed on the market by the Cone Automatic Machine Company, Inc., Windsor, Vermont. A summary of the features of the machine is as follows:

All of the cams are carried on a single cam shaft on the top of the machine and all of these cams are of the flat type, milled to the desired form and bent to fit on the cam drums. This standardization of the cams simplifies the handling of different jobs as it makes easy the setting up of the machine. All of the operating levers and wheels are located at the front of the machine and at such a level from the floor that they are within convenient reach of the operator. The cross-slides are supported by bearings both top and bottom to prevent deflection under the pressure of the cut. The top bearings are finished with gibs to provide for take-up for wear. All of the heavy turning and forming operations are done in the two lower spindle positions; this arrangement has been adopted so that the greater part of the chips fall away into the pan of the machine without accumulating on the work, tools or spindle noses. A deflector is provided to guide the finished work into a box or pan separate from the chips. The chip pan is arranged so that all turnings are removed from the end and the laborer who does this work does not interfere with the machine operator. The spindles are of hardened steel running in phosphor-bronze bearings arranged to easily compensate for wear. The stock is fed from the upper front spindle. Here it is possible to perform the operations of drilling, counterboring, reaming, threading and cutting off the finished piece. The third and fourth positions are on the two upper spindles. The tool-slides are designed to give ample room for a wide range of tool set-ups and there is no front overhang.

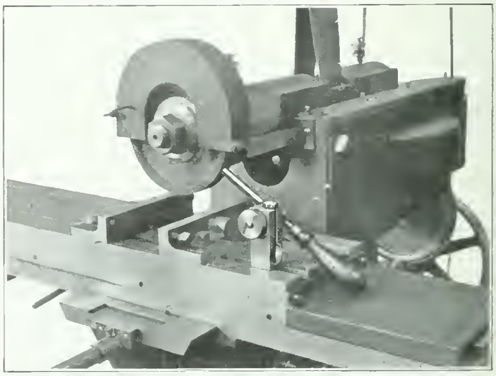


FOUR-SPINDLE AUTOMATIC MACHINE

The Cone automatic is arranged for a single belt drive taking power either from an individual electric motor or from a line shaft.

Hartford Diamond Tool Holder

AN attachment for grinding machines to true the abrasive wheels with a diamond has been placed on the market by the National Machine Tool Company, Hartford, Connecticut, and is called the Hartford Diamond Tool Holder. The accompanying illustration shows its construction. The dimensions are: size overall, 4⅜x3x1¾ inches: diameter of tools 5/16 to 17/32 inches, tightening bold head ½ inch square.



HARTFORD DIAMOND TOOL HOLDER

Personal and Business Items

MR. E. M. OLIN, formerly Superintendent of the test department, of the Westinghouse Electric and Manufacturing Company, at East Pittsburgh, Pa., has been appointed Superintendent and Assistant Treasurer of the Copeman Electric Stove Company of Flint, Mich. This company is a recently acquired subsidiary of the Westinghouse Electric Company and manufactures a line of electric ranges. He succeeds Mr. D. W. Oviatt, who has resigned.

Mr. W. F. Trenary, Jr., with headquarters at 419 Brown-Marx Building, Birmingham, Ala., now represents the Harrison Safety Boiler Works of Philadelphia, manufacturers of the Cochrane Heaters and other steam plant appliances, succeeding Mr. W. R. Jennison.

Mr. Leonard S. Cairns, assistant general manager of the Manila Electric Railroad and Light Company, Manila, P. I., has been appointed general manager of the Eastern Pennsylvania Railways Company, Pottsville, Penn., by The J. G. White Management Corporation, New York City, the operating managers of both companies.

Nagle Corliss Engine Works, Erie, Pennsylvania has opened an Eastern office in the Bourse Building, Philadelphia, Pennsylvania.

Circular No. 160 just issued by Tate-Jones & Company, Inc., Pittsburgh, Pa., is devoted to recuperative gas oven furnaces. Two series of furnaces are described, one designed for the temperature range from 900 to 1600° F. and the other for a range of from 1600 to 2400° F.

The Jeffrey Manufacturing Company of Columbus, Ohio, has begun the issue of a semi-monthly stock list showing all material actually on hand. This list contains all available stock, covering chains and attachments for elevators and conveyors, malleable iron and steel elevator buckets, belt conveyors, spiral conveyers and fittings, take-ups, bearings, hangers, pulleys, etc., together with approximate shipping dates for the various materials. This will be sent free upon request.

The second of a series of catalogs on industrial motors has just been distributed by the Westinghouse Electric and Manufacturing Company of East Pittsburgh, Penn. This is known as catalog 30 and covers the company's complete line of direct current motors and generators for industrial service. After several pages giving general information regarding the ordering, classification and selection of direct current motors there follows complete description, rating and dimensions for type SK commutating-pole motors, various modifications of type SK elevator motors, reversing planer motor equipment. Type CD motors, headstock equipment for woodworking plants, type SK and CD motor generates and arc welding equipment. New information is given especially on such subjects as arc welding, headstock equipment, motion picture service and battery charging service.

Mr. C. G. Young, for many years well known in the public utility field, has entered the organization of Ford, Bacon & Davis. Mr. Young will be particularly engaged on reports and appraisals of public utility and industrial properties.

The Textile Department of The Merchants National Bank of Boston, Mass., has just issued a booklet under the title "Women's Work in War Time." The purpose in publishing it is to assist manufacturers in meeting their labor shortage. Much of the information has been drawn from reports of the British government, and the operations of the leading industries in England where women have replaced men are outlined. The following list of section headings shows the industries covered: The wool industry; cotton industry; printing, bleaching and dyeing; hosiery and knitting; heavy clothing manufacture; light clothing manufacture; leather tanning and currying; boot and shoe manufacture; leather trade; case and fancy leather; the glove industry; soap and candle trades; paper making; glass bottle and flint glass trades; wood-working trades; pottery (coarse ware) and brick trade; china and earthenware trade; silver and electro plate trades; the chemical industries; color, paint and varnish trade; sugar refineries.

The Cleveland Milling Machine Company of Cleveland, Ohio, is publishing on the 15th of every month a booklet entitled "Stock List of Cutters." In its pages are listed standard cutters which are in stock and ready for immediate shipment.

The Fuel Engineering Company of New York City is distributing to power plants a wall poster entitled "SAVE COAL in This Boiler Room and HELP WIN THE WAR." The body of the poster has four reminders which, if followed by the firemen will assist in more efficiently burning coal.

With the first of January, 1918, *Motor Trucks of America* issued by The B. F. Goodrich Rubber Company is ready for distribution. This is the sixth year in which it has been issued. It now consists of 200 pages of reading matter, illustrations and specifications. The value of this book is that it permits buyers to obtain accurate information of all of the leading gas and electric-driven motor trucks to the number of nearly 150; for each model 31 specifications are given.

The Burt Manufacturing Company of Akron, Ohio, has just issued a 128-page catalog covering its entire line of oil filters, exhaust heads and ventilators. Numerous illustrations are used showing both details of the apparatus and its installation in representative plants. Other features of the catalog are price lists of much of the apparatus and a list of representative installations.

Mr. J. H. Pardee, president and Mr. J. P. Ripley, railway engineer, The J. G. White Management Corporation, New York City, are expected to return to New York City about January 15th from a visit to the Philippine Islands. They have been making a general inspection of the Manila Electric Railroad and Light Company and other interests in the Islands operated by the Management Corporation.

As an indication that far-distant trade is still going on in spite of war needs, the Boston Belting Company recently sent 22 tons of rubber belting in a single shipment to Twang Peng, Burma. Before reaching its destination this belting must travel about 18,000 miles, or nearly three-quarter of the distance around the globe.

NOTE: Owing to a slight oversight, the description of Portable Houses furnished by the Kolb Portable Building Company, Inc., in the November, 1917, issue of INDUSTRIAL MANAGEMENT, page 285, was made to read Harrisonburg, *Penn*, instead of Harrisonburg, Virginia. The editors of INDUSTRIAL MANAGEMENT take this opportunity of giving the correct address of the company.

EXPLANATORY NOTE—THE ENGINEERING INDEX

We hold ourselves ready to supply—usually by return of post the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations: and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cents. A denotes a price of 40 cents; B, 60 cents; C, 80 cents; D, $1.00; E, $1.20; F, $1.60. The letter N indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

Serial publications are indexed on the appearance of the first installment.

CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of INDUSTRIAL MANAGEMENT at 10 cents per month, or $1.00 a year: to non-subscribers, 25 cents per month, or $3.00 a year.

REFERENCE LIST OF PUBLICATIONS REGULARLY REVIEWED AND INDEXED

ARRANGED IN ORDER OF THEIR ABBREVIATIONS

A A Wkly	Aerial Age Weekly
AERA	AERA
Aeronts	Aeronautics
A I C E	Amer. Institute of Chemical Engineers
A I E E	Amer. Institute of Electrical Engineers
A I M E	Amer. Institute of Mining Engineers
A I Mt	Amer. Institute of Metals
Am Ec Rev	Amer. Economic Review
Am El-Chem Soc	Amer. Electro-Chemical Society
Am Fdymns Assn	Amer. Foundrymen's Association
Am Ir & Stl Inst	Amer. Iron & Steel Institute
Am Jl Pub Hh	Amer. Journal of Public Health
Am Jl Sci	Amer. Journal of Science
Am Mach	Amer. Machinist
Am Rd Blds Assn	Amer. Road Builders' Association
Am Ry Bdge & Bldg Assn	Amer. Railway Bridge & Building Association
Am Soc Ht & Vt Engrs	Amer. Society of Heat. & Vent. Engrs.
Am Soc Mar Dftn	Amer. Society of Marine Draftsmen
Am Soc Nav Engrs	Amer. Society of Naval Engineers
Am Soc Ref Engrs	Amer. Society of Refrig. Engineers
Am Soc Tes Mat	Amer. Society of Testing Materials
Am Wd Pres Assn	Amer. Wood Preserv. Association
Am Wr Wks Assn	Amer. Water Works Association
A R E A	Amer. Railway Engineering Association
A R M M A	Amer. Raliway Mas. Mech. Assn.
Arch For	Architectural Forum
Arch Rec	Architectural Record
A S C E	Amer. Society of Civil Engineers
A S M E	Amer. Society of Mechanical Engineers
Assn Eng Soc	Association of Engineering Societies
Assn I S E E	Association of Iron & Steel Elec. Engrs.
Aus Min Stan	Australian Mining Standard
Auto	Automobile
Autocar	Autocar
Bkn Engs Cb	Brooklyn Engineers' Club
Bos Soc C E	Boston Society of Civil Engineers
Br Rds & Sts	Better Roads and Streets
Brs Wld	Brass World
Bt Fe & Stl Pt	Blast Furnace & Steel Plant
Can Engr	Canadian Engineer
Can Min Jl	Canadian Mining Journal
Can Soc C. E.	Canadian Society of Civil Engineers
Cas Eng Mthly	Cassier's Engineering Monthly
Cen Ry Cb	Central Railway Club
Chem Eng & Min Rev	Chemical Engineering and Mining Review
C E Soc St P	Civil Engineers Society of St. Paul
Cl Age	Coal Age
Colly Gdn	Colliery Guardian
Col Sl Min Mag	Colorado School of Mines Magazine
Col Univ Qly	Columbia University Quarterly
Com Air Mag	Compressed Air Magazine
Com Vhle	Commercial Vehicle
Comwh Engr	Commonwealth Engineer
Concte	Concrete
Contg	Contracting
Contr	Contractor
Corn C E	Cornell Civil Engineer
Cr Min West Aust	Chamber of Mines of West Australia
E Cb Balt	Engineers' Club of Baltimore
E Cb Phila	Engineers' Club of Philadelphia
E Cb St L	Engineers' Club of St. Louis
Econ Geol	Economic Geology
Eff Soc Jl	Efficiency Society Journal
Elec Jl	Electric Journal
Elec'n	Electrician
Elec Rev	Electrical Review
Elec Rev Chi	Electrical Review, Chicago
Elec Ry Jl	Electric Railway Journal
Elec Wld	Electrical World
Eng & Con	Engineering and Contracting
Eng & Min Jl	Engineering and Mining Journal
Eng Ed	Engineering Education
Eng News Rec	Engineering News-Record
Engng	Engineering
Engr	Engineer
Eng Rv	Engineering Review
Engr Soc Penn	Engineers Society of Pennsylvania
Fkn Inst Jl	Franklin Institute Journal
Flying	Flying
Fndry	Foundry
Gen Elec Rev	General Electric Review
Ht & Vtg Mag	Heating and Ventilating Magazine
Ice & Refrig	Ice & Refrigeration
Ill Eng Soc	Illuminating Engineering Society
Imp Inst Bul	Bulletin of the Imperial Institute
Ind Man	Industrial Management
Inst Aut Engrs	Institute of Automobile Engineers
Inst Rad Engrs	Institute of Radio Engineers
Inst San Engrs	Institute of Sanitary Engineers
Instn C E	Institution of Civil Engineers
Instn E E	Institution of Electrical Engineers
Instn E & S Scot	Inst. of Engrs. & Shpbldrs. of Scot.
Instn Mun & Cnty Engrs	Inst. of Munic. & County Engrs.
Instn Mech Engrs	Institution of Mechanical Engineers
Inst Met	Journal of the Institute of Metals
Instn Min Engrs	Institution of Mining Engineers
Instn Min & Met	Institution of Mining & Metallurgy
Int Mar Eng	International Marine Engineering
Iron Age	Iron Age
Ir & Cl Trds Rev	Iron & Coal Trades Review
Iron Trd Rev	Iron Trade Review
Jl Actcy	Journal of Accountancy
Jl Geol	Journal of Geology
Jl Ind & Eng Chem	Journal of Indust. & Eng. Chemistry
La Eng Soc	Louisiana Engineering Society
La Nat	La Nature
L S Min Inst	Lake Superior Mining Institute
Machy	Machinery
Manr Assn Engs	Manchester Assn. of Engineers
Mfrs Rec	Manufacturers' Record
Mar Eng & Nav Arch	Marine Engineer & Naval Architect
Mar Rev	Marine Review
Mas Boil Mkrs Assn	Master Boiler Makers' Association
M C B A	Master Car Builders' Association
Mech Eng	Mechanical Engineering
Mech Wld	Mechanical World
Met & Chem Eng	Metallurgical & Chemical Engineering
Min Mag	Mining Magazine
Min & Met Soc Am	Mining & Metallurgical Soc. of Amer.
Min & Sci Pr	Mining & Scientific Press
Mun Eng	Municipal Engineering
Mun Engrs Jl	Municipal Engineers' Journal
Mun Jl	Municipal Journal
Nat Assn Corp Schls	National Assn. of Corporation Schools
Nat Engr	National Engineer
Nat Lime Mfrs Assn	National Lime Manufacturers' Association
Nature	Nature
N E C Instn	N-E Coast Institution
N E Rd Cb	New England Railroad Club
N E Wr Wks Assn	New England Water Works Assn.
N Y Dept Labor	New York State Dept. of Labor
N Y Rd Cb	New York Railroad Club
Per-Way Instn	Permanent-Way Institution
Phil Jl Sci	Philippine Journal of Science
Power	Power
Pwr Pt Eng	Power Plant Engineering
Prof Mem	Professional Memoirs
Quarry	Quarry
Roy Un Ser Instn	Royal United Service Institution
Ry Age Gaz	Railway Age Gazette
Ry Cb Pitts	Railway Club of Pittsburgh
Ry Engr	Railway Engineer
Ry Gaz	Railway Gazette
Ry & Loco Eng	Railway & Locomotive Engineering
Ry Mech Engr	Railway Mechanical Engineer
Ry Rev	Railway Review
Ry Sig Engr	Railway Signal Engineer
S A E	Society of Automobile Engineers
Schl Min Qly	School of Mines Quarterly
Sfty Eng	Safety Engineering
Sib Jl Eng	Sibley Journal of Engineering
So Af Inst Engrs	South African Instn. of Engineers
Soc Nav Arch & Mar Engr	Society of Naval Arch. & Mar. Engrs.
Soc Pro Sci Man	Soc. to Promote Sci. of Management
S & S W Ry Cb	Southern & Southwestern Railway Club
St L Ry Cb	St. Louis Railway Club
Stev Indic	Stevens Indicator
Stl & Iron	Steel & Iron
Surv'r	Surveyor & Municip. & County Engr.
Tel Engr	Telephone Engineer
Telephony	Telephony
Times Eng Supp	Times Engineering Supplement
Tmwy & Ry Wld	Tramway & Railway World
Univ Col Jl Eng	Univ. Colo. Journal of Engineering
Univ Ill	University of Illinois
Univ Kan	University of Kansas
Univ Minn	University of Minnesota
Univ Mo	University of Missouri
U S Bur Mines	U. S. Bureau of Mines
U S Bur Stds	U. S. Bureau of Standards
U S Dept Ag	U. S. Dept. of Agriculture
U S Geol Surv	U. S. Geological Survey
U S Nat Inst	U. S. Naval Institute
West Eng	Western Engineering
West Ry Cb	Western Railway Club
West Scot I & S Inst	West. Scotland Iron & Steel Inst.
West Soc Engrs	Western Society of Engineers
Wis Engr	Wisconsin Engineer
Worc Poly Inst Jl	Worcester Polytechnic Inst. Journal

The Engineering Index

The following pages form a *descriptive* index to the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world in the English, French, Dutch, Italian and Spanish languages, as far as possible on account of war.

The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us.—See the Explanatory Note on the opposite page, where also the full titles of the principal journals indexed are given. This list is subject to change from time to time.

NOTE.—The Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

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INDUSTRIAL MANAGEMENT

EDUCATION

Applied Science

What the Empire Owes to Applied Science (82376 A). 2200 w. Engr—Oct. 26, 1917. Developments at Hong Kong. Shipbuilding, public works, and other industries.

Aptitude

The Indications of a Natural Aptitude for Mechanical Engineering (82412 A). Sanford A. Moss. 1500 w. Eng Ed—Oct., 1917. The signs that should decide in the selection of a career: theory as applied to the case of mechanical engineers.

Education Bill

The Education Bill: Its Objects and Its Reference to Industry (82300 N). H. A. L. Fisher. Address at Manchester, Eng. 4000 w. Beama Jl—Oct., 1917. Scheme to extend the facilities for public education in England.

Engineering Graduates

Engineering Graduates and Industrial Demands (82414 A). L. W. W. Morrow. 9 pp. Eng Ed—Oct., 1917. Reply to criticisms on present educational methods and engineering curriculums.

Engineers

The training of Engineers (82677). 2600 w. Times Engng Supp—Oct. 26, 1917. Proposed methods of rendering engineers' training more effective through centralization of effort

The Budding Engineer (82357 A). Ills. 2000 w. Autocar—Oct. 27, 1917. Outline of methods adopted in the school of the Metropolitan and City Police Orphanage, England.

The Training of Engineers (82558 A). 3000 w. Engr—Nov. 2 1917. Account of meeting in London to discuss the desirability of forming a Central Organization for improvement of engineering training.

A Study of Engineering Enrollment. (82416 A). Calvin H. Grouch. 1500 w. Eng Ed—Oct., 1917. Curves showing data collected, with explanatory notes.

Mathematics

Engineering Mathematics (82409 A). Otto B. Goldman. 28 pp. Ore Soc Engrs, Jl—Oct., 1917. Serial, 1st part. Lectures on physical, mechanical and engineering problems

Mechanics

Elementary Structural Mechanics (82408 A). C B. McCollough. Ills. 17 pp. Ore Soc Engrs, Jl—Oct., 1917. Serial, 1st part. First of a series of lectures. First two on structural mechanics; later lectures on structural analysis.

Motor Mechanics

The Red Cross School of Motor Mechanics (82564 A). Ills. 2000 w. Autocar—Nov. 3, 1917. Practical help for interned British prisoners in Switzerland.

Research

Research and the State (82661 A). 2300 w. Nature—Oct. 18, 1917. Importance of National laboratories and their value to industry.

Universities and the Supply of Research Workers (82663 A). 2100 w. Nature—Nov. 8, 1917. Advantage of University scholarships. Results in England.

The Answer of the American Chemists and Chemical Industry (82627 A). Thomas B. Brighton. 3500 w. Utah Soc Engrs Mthly Jl—Sept., 1917. Shows the importance of chemical research.

Research Laboratory

British National Physical Laboratory (82644 A). I. W. Chubb. 4000 w. Ind Man—Dec., 1917. Review of services rendered and the value to industry.

FINANCE AND COSTS

Accounting

Depreciation Accounting for Public Utility Companies (82184). Frank E. Seidman. 10 pp. Jl Actcy—Nov., 1917. Regulations prescribed by the New York public service commission of the first district.

Importance of Proper Accounting (82211) William M Brown. 4000 w. Telephony—Nov 3, 1917 Trend toward standardization of methods. Read at convention of Southern States Independent Telephone Assn.

Property Accounting in the City of New York (82183 A) Raymond W. Bourke. 13 pp. Jl Actcy—Nov., 1917 Discusses accounting for equipment-in-service.

The Elements of Cost Accounting (82182 A). F. C. Belser 15 pp. Jl Actcy—Nov., 1917 Outlines the various systems

Appraisal

Reproduction Method of Appraisal (82620 A) Charles W McKay 3000 w. Ind. Man Dec, 1917 Reviews methods formerly used and outlines the reproduction-cost-method and its application.

Business Prospects

What Will Business Be After the War? (82639 A). J. P. Brophy. 1600 w. Ind Man—Dec., 1917. Remarks on the excessive optimism, giving reasons for opinions.

Business Systems

Modern Business Systems and the Engineer (82417 A). E. J. McCaustland. 4500 w. E Cb St L, Jl—Sept.-Oct., 1917. Reasons why engineers should interest themselves in business affairs.

Civil Engineers

A Study of the Earnings of Civil Engineering Graduates (82415 A). Louis Mitchell. 500 w. Eng Ed—Oct., 1917. Charts and notes on a recent study.

Cost System

The Semi-Automatic Cost System (82633 A). F. A. Guignen. Tables, 500 w. Ind Man—Dec., 1917. Novel method of recording costs by a system of cross-posting.

Depreciation

Depreciation of Plant (82196 A). F. T. Clapham. 2200 w. Mech Wld—Oct. 19, 1917. Relation of depreciation and maintenance; points useful in fixing rates, etc.

Theoretical Depreciation (82308 A). James E. Allison. 11,000 w. Tel Engr—Nov., 1917. Problem of depreciation in public utilities as a part of the problem of valuation. Critical discussion.

Organization

Standard Factory Organization (82139 A). 2000 w. Engng —Oct. 12, 1917. Notes on problems involved in connection with the financial organization of factories.

Raliroad Securities

Bankers Report on Railroad Securities (82476) 3500 w. Ry Age Gaz—Nov. 16, 1917. Unsatisfactory condition of railroad credit and conditions necessary to re-establish it.

MANAGEMENT

Australia

Works Management and the Industrial Position in Australia (82370 N). Ralph N. Lewis. 2000 w. Comwh Engr—Oct., 1917. Effects of the systems installed. Favors the principles embodied in the Taylor system.

Bonus System

Giving the Foreman a Bonus (82172). C. B. Lord. 2000 w. Am Mach—Nov. 1, 1917. Unusual method of calculating the bonus.

Control System

Lodge and Shipley Control System (82632 A). D. M. Perrill. Ills. 3000 w. Ind Man—Dec., 1917. Second article of serial on methods in use to control production.

Employment

Employment Service Department for a Plant of 2500 Employees (82157 A). H. L. Robinson. 1200 w. Sfty Eng—Oct., 1917. Methods and work.

Factory Lighting

The Problem of Daylight in Its Relation to Management (82631 A). C. E. Clewell. Ills. 3000 w. Ind Man—Dec., 1917. Importance of providing light of uniform quality and proper degree.

Human Factor

The Human Factor in Industry (82684 A). G. E. Toogood. 5000 w. Cassier's Engng Monthly—Nov., 1917. A modern view of the principles of the human influence on industrial activities.

Industrial Problems

England Overcame Labor and Industrial Crisis by Intelligence (82583). Condensed addresses by Sir Stephenson Kent, G. H. Baillie, H. W. Garrod, and Cyril Asquith. 3500 w. Eng News-Rec—Nov. 22, 1917. Methods of meeting industrial problems.

Industry

Causes of Industrial Unrest: the Remedies. (82301 N). F. Dudley Docker. 2000 w. Beama Jl—Oct., 1917. Refers mainly to conditions in England.

Industrial Re-construction After the War: the Lines on Which a Solution Might Proceed (82298 N). Victor Fisher. 2200 w. Beama Jl—Oct., 1917. Perplexities of the situation.

Organizing Industrially for War (82642 A). C. E. Knoeppel and G. Sumner Small. 5500 w. Ind Man—Dec., 1917. Second article of a serial, showing need of co-operation.

Labor Problem

Labor-Turnover Records and the Labor Problem (82258 A). Richard B. Gregg. 2000 w. A S M E, Jl—Nov., 1917. Advocates application of analysis to labor turnover.

Organization

See same heading under Finance and Costs.

Salariat

The Judgment of the Salariat (82209 N). T. C. Elder. 1700 w. Beama Jl—Oct., 1917. The position and influence of salaried workers.

Taylor System

Maintenance of Machinery and Equipment (82683 E). H. K. Hathaway. 1200 w. Bul Taylor Society—May, 1917. Maintenance of machinery and equipment as a part of the Taylor system.

Wage Systems

Les Salaires Owniers (82700 C & D). H. Le Chatelier. 3500 w. Revue De Metallurgie—July-Aug., 1917. Review of various wage and bonus systems.

A "One-Price" System of Wages (82634 A). E. F. Henry. 1500 w. Ind Man—Dec., 1917. Appeal for a definite standard of wages.

Discontent and the Wage System (82297 N). S. G. Hobson. 3000 w. Beama Jl—Oct., 1917. New ideas and theories in Great Britain.

The War Bonus and Electric Railways (82160 A). E. G. Connette. 2500 w. A E R A—Oct., 1917. System in effect in England, Canada, and some American cities.

Les Formules De Salaire Moderne (82659 C + D). M. Goupil. 3500 W. Annals Des Ponts Et Chaussées—July-Aug., 1917. Theory of wage systems of Taylor, Lallemand, Halsey, York, Rowan, Carvallo and others. Reduction to mathematical expressions.

Wastage

Wastage in the Factory (82363 A). James Edgar. 1200 w. Mech Wld—Oct. 26, 1917. Calls attention to waste and advantages from factory economies.

Waste

Eliminating Wastes in Factory Office Supplies (82630 A). Frederick J. Knoh. 1500 w. Ind Man—Dec., 1917. Large savings possible through more systematic ordering and keeping of records.

Industrial Waste—A Tax Paid to Ignorance (82628 A). William N. Berkeley. 800 w. Ind Man—Dec., 1917. Calls attention to waste of natural resources and manufactured products.

REGULATION

Chemical Industries

The Tariff Commission and Our Chemical Industries (82185 B). William S. Culbertson. 2800 w. Jl Ind & Eng Chem—Nov., 1917. A study of electro-chemical industries, potash, explosions and nitrates, coal-tar dyes, etc.

Coöperation

Report of Committee on Engineering Coöperation (82462 D). 13 pp. Am Soc Ht & Vt Engrs, Jl—Oct., 1917. Includes paper by F. H. Newell, on "A Practical Plan of Engineering Coöperation."

Economics

Food Conservation and the War (82623 B). Herbert C. Hoover. 2000 w. Am Jl Pub Hh—Nov., 1917. Outlines the necessities of the world at the present time.

Industrial Peace

Industrial Peace—First Essential in Winning War. (82591). Sir Stephenson Kent. 2500 w. Auto Ind—Nov 22, 1917. A concise summary of the British situation and the labor problem

Labor Problems

Mental Examination for Employees (82635 A). C. S. Rossy. 3500 w. Ind Man—Dec., 1917. Needs of mental examination and classification of defects.

Manufacturing

Concentrating for Real War Work (82578 A). 2500 w. Iron Age—Nov. 22, 1917. Bureau of manufacturing industries to be organized.

Public Utilities

Public Utility Rates (82262 A). H. S. Cooper. 6500 w. Gen Elec Rev—Nov., 1917. Factors which influence rates. Shows that inspection of rate schedules by the comparison method is fallacious.

Regulating Public Utilities in Ohio (82229). 3500 w. Elec Ry Jl—Nov 3. 1917. Deals with the organization of the Ohio Public Utilities Commission and shows the varied kinds of work being carried on.

Railways

Railway Regulation and Control. (82331) 3000 w. Ry Age Gaz—Nov. 9, 1917. Hearings at San Francisco before the Congressional Joint Committee on Interstate Commerce.

Tariff Commission

The Tariff Commission and Its Operation with Reference to the Chemical Schedule. (82186B). Grinnell Jones. 2200 w. Jl Ind and Eng Chem—Nov., 1917. The work of the Commission.

Women Workers

Women as Substitutes for Men Employees. (82161A). F. W. Brooks. Ills. 3000 w. AERA—Oct., 1917. Gives opinions of railway managers in Great Britain and Italy.

WELFARE AND SAFETY

Accident Prevention

Accident Prevention in the Telephone Field. (82306A).

J. F. Naylon. 2500 w. Tel Engr—Nov., 1917. Problem largely one of educating employees.

Accident Prevention in the Textile Industry. (82259A). David S. Beyer. Ills. 3500 w. A S M E, Jl.—Nov., 1917. Methods of mechanical protection are described, and factors causing accidents discussed.

Accidents

Accidents on Overhead Traveling Crane Runways. (82390). 1800 w. Trav Stand—Nov., 1917. Calls attention to infrequent accidents which occur in crane work.

Army Subsistence

How France Subsists Her Armies at the Front. (82531B). Translated from *L'Illustration.* Ills. 15 pp. Prof-Mem—Nov.-Dec., 1917. Demand and supply methods of transport, etc.

Cripples

Employment for Disabled Men. (82670). 3000 w. Times Engng Supp—Oct. 26, 1917. Possibility of employing men disabled in war in the engineering trades.

Danger Signs

New Ideas in Danger Signs. (82215). W. L. Chandler. Ills. 2500 w. Cl Age—Nov. 3, 1917. Criticism of the usual danger signs, with suggestions.

Eye Protection

New Kinks in Eye Protection. (82614A). L. L. Park. 1500 w. Sfty Eng—Nov., 1917. Forms of protectors.

Fatigue

The Textile Industry (82679). 2000 w. Times Engng Supp—Oct. 26, 1917. Industrial fatigue, particularly in the textile industries in England.

Fire Protection

Fire Protection in Industrial Plants. (82442F). C. W. Johnson. 3000 w. A I Mt, Jl—Sept.. 1917. Elimination of causes; protection against spreading; and extinguishing, outlining principles.

Linemen

Safety for Electric Linemen. (82389). Ills. 10 pp. Trav Stand—Nov., 1917. Calls attention to prime requisites for safety.

Low Voltage

Low Voltage Hazards. (82615A). C. A. Lauffer. 7000 w. Sfty Eng—Nov., 1917. Applies to circuits of 600 volts and under. Dangers, precautions, treatment of injuries, etc.

Maritime Work

Accident Hazards in Maritime Work. (82121A). F. L. Hoffman. 1800 w. Mar Rev—Nov., 1917. Analysis of the accident record of the American merchant marine.

Mechanical Arms

Mechanical Arms for Maimed Soldiers. (82290A). Ills. 2200 w. Engr—Oct. 19, 1917. Serial. 1st part. The problem and the difficulties and requirements.

Poisonous Gas

Poisonous Gas in Warfare—Application, Prevention, Defense, and Medical Treatment. (82533B). 25 pp. Prof-Mem—Nov.-Dec., 1917. A short, annotated bibliography of gases and kindred devices applied in the present war. Prepared by Henry E. Haferkorn, assisted by Felix Neumann.

Safeguards

Mechanical Safeguards. (82156A). David S. Beyer. Ills. 4000 w. Safety Eng—Oct., 1917. Their value and importance.

Safety Engineers

Duties of the Safety Engineer. (82158A). David Van Schaack. 4000 w. Sfty Eng—Oct., 1917. Outlines the work and opportunities in accident prevention.

Safety Orders

General Construction Safety Orders of the California Industrial Accident Commission. (82354) 5500 w. West Eng—Nov., 1917. Orders prepared by committees of different interests involved.

Steel Cars

Hazards in Connection with the Reaming and Riveting of Steel Cars. (82155A). Harry Guilbert. Ills. 2500 w. Sfty Eng—Oct., 1917. Some of the common hazards and ways of avoiding them.

MISCELLANY

Chemical Industry

The Future of Chemical Industry in the United States. 82187B). L. H. Baekeland. 4000 w. Jl Ind and Eng Chem—Nov., 1917. Its future permanence, its needs and problems.

Engineers

Awakening Recognition of the Engineer. (82616). Fraser S. Keith. 3800 w. Can Engr—Nov. 22, 1917. Address before Ottawa Branch of the Can. Soc. of Civ. Engrs. Plea for greater recognition.

The Engineer of To-day. (82686B). Henry J. Burt. 4000 w. Iowa Eng Soc Pro—Feb., 1917. Analyzses the present situation.

Under New Management — The Engineering Mind. (82643A). Charles M. Horton. 2500 w. Ind Man—Dec., 1917. Plea for broader education and experience.

MECHANICAL ENGINEERING

AERONAUTICS

Aeronautic Maps

Aeronautic Maps and Aerial Transportation. (82351A). Henry Woodhouse. Ills. 10 pp. Flying—Nov., 1917. Types, and air traffic, with topics related.

Aeroplanes

Aeroplane Limits. (82556A). 1000 w. Engng—Nov. 2, 1917. Limit of the useful load.

Aerostatics

Co-operation Between Balloons and Artillery. (82218). D. Rainsford Hannay. Ills. 1500 w. A A Wkly—Nov. 5, 1917. Describes working of a balloon section of the British Army in the field.

Firing at Captive Balloons and Proposed Aids in the Direction of Fire Against Aircraft. (82467). Allan Cyrus. 2000 w. A A Wkly—Nov. 19, 1917. Construction and use of the computing stick.

Aircraft

Felt in Aircraft Construction. (82466). S. W. Widney. 1800 w. A A Wkly—Nov. 19, 1917. Uses of felt; different grades, etc.

Engines

Aviation Engine Development. (82611). E. H. Sherbondy. Ills. 1800 w. A A Wkly—Nov. 26, 1917. Serial, 1st part. Reviews early development and difficulties of construction.

The 170 Horse Power Mercedes Aviation Motor. (82217). E. H. Sherbondy. Ills. 2000 w. A. A. Wkly.—Nov. 5, 1917. Details of one of the five types standardized by the German War Office.

Flying

A Further Three Years' Flying Experience. (82277A). B .C. Hucks. Extract from paper before the Aeronautical Soc. of Gt. Britain. 6500 w. Roy. Soc. Arts, Jl—Oct. 19. 1917. Recent improvements; differences in machines; causes of crashes; training, etc.

Specifications

International Aircraft Standards. (82352A). 13 pp. Flying—Nov., 1917. Specifications adopted by the International Aircraft Standards Board.

Stabilizers

La Stabilisation Des Navires Et Des Avions. (82654B). H. Volta, Ills. 2200 w. La Nature—Oct. 20, 1917. Gyroscopic stabilizers for ships and airplanes.

AUTOMOBILES

Automotive Engineering

Automotive Engineering in the War. (82151A). George W. Dunham. Address at Buffalo. 3000 w. S A E, Jl—Oct., 1917. Outlines the activities, which include transporting men and munitions; motorization of field artillery; purpose of "Liberty Engine," development of farm tractors, etc.

Axles

The Ralls Axle Suspension. (82358A). Ills. 2000 w. Autocar—Oct. 27, 1917. A device which allows horizontal as well as vertical movement of the axle.

Coal Gas

Coal Gas for Motor Vehicles. (82675). 1400 w. Times Engng Supp—Oct. 26, 1917. Methods of storage discussed before Manchester and Liverpool District Commercial Motor Users' Association.

Coal Gas for Motor Traction. (82662A). H. E. Wimperis Ills. 1000 w. Nature—Nov. 1, 1917. Gasoline Motor bus adopted to use coal gas as fuel.

Coal Gas for Motor Traction. (82278A). W. M. Barrett. With review by Rayner Roberts. Ills. 8500 w. Autocar—Oct. 20, 1917. Subject received and progress reported. Systems described and criticized.

Coal Gas for Motor Traction. (82135 A). 3000 w. Mech Wld—Oct. 12, 1917. Serial. 1st part. Report of the Executive Committee of the British Commercial Gas Association. Advantages and disadvantages.

Electric Tractors

New Freight-Handling System at Gotham Dock Eliminates Motor Truck Delays. (82251 A). Ills. 1500 w. Com Vhle—Nov. 1, 1917. Electric industrial trailers and tractors accomplish work more cheaply than men.

Headlights

The Automobile Headlighting Problem Again. (82265A).

[illegible] J. Edwards. Ills. 1800 w. Gen Elec Rev—Nov., 1917. Analyzes the advantages and disadvantages of the fixed, the controllable, and the diffusing systems, recommending the controllable.

Inspection

Inspection. (82681). 1300 w. Times Engng Supp.—Oct. 26, 1917. Presidential address to Institution of Automobile Engineers of Great Britain. Women inspectors and their work.

Metallurgy

Metallurgy in the Automotive Industry. (82152 A). Ralph H. Sherry, 10500 w. S A E, Jl—Oct, 1917. Shows the connection between metallurgical and factory work.

Military Trucks

Acceptance of Military Trucks. (82150A). Ills. 3500 w. S A E, Jl—Oct., 1917. Report of acceptance of the first two heavy duty (Class B) war trucks, giving details of design.

Motorcycles

The Harley-Davidson Motorcycle. (82592). Ills. 3000 w. Auto Ind—Nov. 22, 1917. Detailed description.

New Trucks

1918 Motor Trucks and Their Makers. Plans in Brief Illustrated Résumé. (82512). Ills. 21 pp. Com Vhle—Nov. 15, 1917. Serial. 1st part. New models and prices, changes in construction and methods of manufacture.

New Truck Has Air Suspension. (82324). Ills. 700 w. Auto Ind—Nov. 8, 1917. Adjustable pneumatic springs care for variations in load.

Petrol

Further Petrol Restrictions. (82279A). Ills. 2500 w. Autocar—Oct. 20, 1917. Full text of motor spirit restriction order coming into effect Nov. 1st, in England.

Steam Motors

The Steam Motor in the Automotive Field. (82261A). E. T. Adams. 2200 w. A S M E, Jl—Nov., 1917. Its advantages for this service; reduction in cost, etc.

Truck Factory

A Pacific Coast Truck Factory. (82471). Frank A. Stanley. Ills. 1500 w. Am Mach—Nov. 15, 1917. Methods used in the largest motor truck factory west of the Mississippi River.

Trucks

Unusual Material in Riker Truck. (82325). Ills. 2000 w. Auto Ind—Nov. 8, 1917. Special steels used. Cost a secondary consideration.

Water Injection

Water Injection May Increase Power. (82468). J. Edward Schipper. 1200 w. Auto Ind—Nov. 15, 1917. With kerosene fuel and certain speeds water injection permits more spark advance, hence gives more power.

HEATING AND COOLING

Air Conditioning

Effect of Air Conditioning Upon Munitions Manufacture. (82461D). J. Irvine Lyle. Ills. 10 pp. Am Soc Ht & Vt Engrs, Jl—Oct., 1917. Presidential address. Describes process of timing fuse for shrapnel shells.

Air Washers

Report of Committee on Standard Method of Testing Air Washers. (82463D). 1200 w. Am Soc Ht & Vt Engrs, Jl—Oct., 1917.

Dehydration

Address on Dehydration. (82464D). H. C. Gore, with discussion. 18 pp. Am Soc Ht & Vt Engrs, Jl—Oct., 1917. Methods and results.

Enameling Ovens

Heat Calculations for Baking and Drying Ovens. (82178). Wirt S. Scott. Ills. 1500 w. Elec Jl—Nov., 1917. Cost of coal, gas and electricity compared, advantages of electricity, etc.

Hot Water

Calculations and Analysis of a Compound Gravity Low-Pressure Hot Water System. (82459D). A. J. Wells. 21 pp. Am Soc Ht & Vt. Engrs, Jl—Oct., 1917.

Gli Impianti Di Riscaldamento A Circulazione Accelerate (82695B). M. Lombardi. Ills. 1500 w. Industria—Oct. 21, 1917. House heating plant with forced circulation. Tests.

Radiation

An Easy Way of Figuring Radiation. (82691). K. Toensfeldt. 1000 w. Power—Nov. 27, 1917. Charts showing the heat losses and radiation required for 13-, 18-, and 22-in. brick walls.

Refrigeration

Carbonic Anhydride Refrigeration Plants. (82526). Ills. 1500 w. Ht & Vt Mag—Nov., 1917. Requirements; comparison with ammonia plants, etc.

Circulation in Flooded System. (82398). Ills. 1500 w. Pr Pt Eng—Nov. 15, 1917. A. H. Baer describes interesting experiments on the behavior of liquid ammonia.

Electricity Applied to Mechanical Refrigeration. (82179). Harry D. McKinney. Ills. 2500 w. Elec Jl—Nov., 1917. The absorption and compression systems explained; comparisons of prime movers for compressors.

Hints on Ammonia-Compressor Lubrication. (82522). E. W. Miller. 1500 w. Power—Nov. 20, 1917. Too much oil; blowing out oil trap; quality of oil.

Purification of Distilled Water. (82227A). Harry B. Hommon, 2,000 w. Ice & Refrig. Nov., 1917. Criticisms and suggestions to prevent water from being contaminated.

Soft Coal

The Economical Purchase and Use of Soft Coal for Heating Homes. (82113). Ills. 2500 w. Ht & Vt Mag—Oct., 1917. Information from a circular compiled by the Engineering Experiment Station of the University of Illinois.

Steam Heating

One-Pipe Gravity Steam Heating Systems. (82525). Harold L. Alt. Ills. 3500 w. Ht & Vt Mag—Nov., 1917. Essential points of design.

Steam Mains

Expansion Bends. (82540A). Ills. 1200 w. Mech Wld—Nov. 2, 1917. Approximate investigation to determine means of quickly finding the dimensions of a horse-shoe bend.

Thermics

Thermics. (82407A). Otto B. Goldman. 30 pp. Ore Soc Engrs, Jl—Oct., 1917. Serial. 1st part. Present article deals with the properties of heat.

Ventilation

A Survey of Cloth Window Ventilation. (82544). John B. Todd, in *School and Science*. 1800 w. Ht. & Vt Mag—Nov., 1917. Schools using cloth screens, and conclusions.

Ventilation of Army Barracks. (82460D). W. J. Mauer, with discussion. Ills. 21 pp. Am Soc Ht & Vt Engrs, Jl—Oct., 1917. Defects in construction of the new barracks from a standpoint of ventilation and sanitation.

HYDRAULIC MACHINERY

Centrifugal Pumps

Testing Chicago's New Centrifugal Pumps. (82225). Ills. 2500 w. Power—Nov. 6, 1917. Tests of two 30,000,000-gal. steam-turbine, reduction-gear centrifugal pumps equipped with hydraulic-driven auxiliaries.

Turbines

Steps in Turbine-Runner Design That Engineers Should Know. (82205). Walter C. Pomeroy. Ills. 2000 w. Eng. News-Rec.—Nov. 1, 1917. Design of hydraulic turbines and turbine runners.

MACHINE ELEMENTS AND DESIGN

Bearings

Bearings. (82397). 1000 w. Pr Pt Eng—Nov. 15, 1917. Serial. 1st part. Composition of alloys employed.

Casting Bearings in Sand and Metal Moulds. (82444F). R. R. Clarke. 5500 w. A I Mt, Jl—Sept., 1917. Practice and experience.

Gears

Heat Treatment and Hardening of Gears. (82568). W. H. Phillips. Read before Am. Gear Mfr.'s Assn. 2500 w. Am Mach—Nov. 22, 1917. Outlines modern methods.

The Inspection of Gears. (82130A). Benjamin F. Waterman. 2500 w. Machy—Nov., 1917. Testing spur, bevel, helical, and worm gears.

Springs

Design of Coil Springs. (82593). W. Ferrier Brown. Ills. 900 w. Auto Ind.—Nov. 22, 1917. With special reference to valve springs for automotive engines.

Tool Designing

Efficiency in Tool Designing. (82125A). F. B. Jacobs. 2500 w. Machy—Nov., 1917. Methods of making tool designs; satisfactory drawing paper; checking a drawing.

The Executive as a Tool Designer vs. the Professional Tool Designer. (82316). Donald Baker. 1500 w. Am Mach—Nov. 8, 1917. Arguments in favor of the practical professional tool designer.

MACHINE WORKS AND FOUNDRIES

Ammunition

Ammuntion Problems in War Time. (82393A). A. L. Humphrey, with short discussion. Ills. 23 pp. Ry Cb Pitts, Pro—Sept. 28, 1917. Explains the enormity of the undertaking, giving details of the work in manufacturing shells.

Brass

Brassfoundry Notes. (82542A). J. Peers. 1500 w. Mech Wld—Nov. 2, 1917. Methods used to prevent waste.

Heat Treatment of Brass in Neutral and Reducing Atmospheres. (82571). A. H. White and B. A. Standerline. 2500 w. Brs Wld—Nov., 1917. Report of experiments and results.

Fuel Economy Possibilities in Brass Melting Furnaces. (82144A). L. C. Harvey. Ills. 4000 w. Engng—Oct. 12, 1917. Suggestions as possible means of improving efficiencies of pit-fire furnaces for coke, oil or gas. Survey of fuel costs.

Brass Shells

Brass-Shell Drawing and Re-drawing. (82321). George F. Kuhne. Ills. 1500 w. Am Mach—Nov. 8, 1917. Causes of defective work and methods of avoiding them.

British Workshops

British Workshops and the War. (82154A). Christopher Addison. 4500 w. S A E, Jl—Oct., 1917. Account of the wonderful industrial development as a result of the war.

British Workshops and the War. (82317). Extracts from report of Christopher Addison. Ills. 2500 w. Am Mach—Nov. 8, 1917. Résumé of their accomplishments since the beginning of the war.

Broaches

Designing and Using Broaches. (82319). W. G. Groocock. 2500 w. Am Mach—Nov. 8, 1917. Arguments in favor of notching broach teeth, with other useful information.

Bullets

Notes on Shrapnel Bullets. (82447F). Harold J. Roast 1800 w. A I Mt, Jl—Sept., 1917 Methods of manufacture of the regular British shrapnel.

Calipers

Common and Special Micrometer Calipers (82128A). F. Server. Ills 2500 w. Machy—Nov., 1917. Illustrations of use in toolmaking and manufacturing.

Castings

Casting Floor Plate and Bed for a Boring Mill. (82233). William J. Kihn. Ills. 1200 w. Fndry—Nov. 1917. How a large molding job was successfully handled.

How Automobile Motor Castings Are Molded. (82230). Ills. 2500 w. Fndry—Nov., 1917. Molding methods employed by the Ferro Machine Foundry Co., Cleveland.

Some Comparative Tests on Test-Bars and Actual Castings. (82452F). W. M. Corse and G. F. Comstock. Ills. 1200 w. A I Mt, Jl—Sept., 1917 Results of tests and information of value.

The Swelling of Zinc Base Die Castings. (82448 F). H. M. Williams. 900 w. A I Mt, Jl—Sept., 1917. Results of investigations.

Core Ovens

Electrically Heated Core Ovens. (82451F). C. F. Hirshfeld. 2500 w. A I Mt, Jl—Sept., 1917. Suggestions for electric core baking, giving results of experimental study.

Crucibles

How the War Affects Manufacture of Crucibles. (82234). M. McNaughton. 1500 w. Fndry—Nov., 1917. Imports of plumbago and German clay cut off. Experiments with substitute materials. Read at Boston meeting of Am Inst. of Metals.

Daylight

Daylight Facilities in Industrial Plants. (82129A). C. E. Clewell. Ills. 3000 w. Machy—Nov., 1917. Factors governing the amount of light transmitted through windows.

Daylight in the Modern Shop. (82174). C. E. Clewell. Ills. 2000 w. Am Mach—Nov. 1, 1917. Factors that affect the lighting, showing a number of glass arrangements.

Dies

Forging Machine Die Design. (82124A). E. R. Frost. Ills. 3000 w. Machy—Nov., 1917. Rules governing the length of upset in terms of bar diameter.

Electrical Works

Empress Works, Huddersfield. (82292A). Ills. 1000 w. Engr—Oct. 19, 1917. Details of new electrical engineering works.

End Mill

An Inserted Tooth End Mill. (82362A). Ills. 700 w. Mech Wld—Oct. 26, 1917. A built-up end mill, a drilling jig, and a special appliance in the making of the same are shown.

Factory Lighting

See same heading under **INDUSTRIAL MANAGEMENT, Management.**

Foundry Efficiency

Reflections from the Fettling Shop of a Steel Foundry. (82195A). J. Watson. From a paper before the British Found Assn. Ills. 3000 w. Mech Wld—Oct. 19, 1917. Methods of manufacture in the molding shop are discussed.

Foundry Metals

Dealing With Foundry Metals Melting at High Temperatures. (82364A). Walter J. May. 2500 w. Mech Wld—Oct. 26, 1917. Materials, furnaces and fittings, and treatment of metals in getting them ready for casting.

Grinding

Plain Cylinder Grinding Work. (82401A). 2500 w. Ry Mech Engr—Nov., 1917 Grinding machines handle some classes of work better than the lathe.

Gun Equipment

Building Carriages, Caissons and Limbers for 75 MM Guns. (82315). M. E. Hoag. Ills. 1500 w. Am Mach—Nov. 8, 1917. Serial. 1st part. Methods used at the Rock Island arsenal in the manufacture of gun equipment.

Hobbing Machines

Operating Instructions for Hobbing Machines. (82126A). Robert E. Newcomb. Ills. 2000 w. Machy—Nov., 1917. Instructions for Gould & Eberhardt 72x20-inch automatic spur and helical gear hobbing machine.

Joints

Riveted Joints. (82545A). W. K. Wilson. Ills. 2000 w. Mech Wld—Nov. 9, 1917. Determining the strength.

Keyways

Cutting Keyways. (82538A). J. Francis. Ills. 1100 w. Mech Wld—Nov. 2, 1917. Tools and methods used.

Metallography

The Role of Metallurgy in the Foundry (82235). Robert J. Anderson. Read before the Am. Fndry. Assn. Ills. 3500 w. Fndry—Nov., 1917. How the microscope can be used to test and control product.

Molding

Emergency Jobs. (82539A). F. Andrew. Ills. 1800 w. Mech Wld—Nov. 2, 1917. Describes the molding of two square pipes and a half-circular wheel guard. Unusual methods.

Oil Furnace

How an Oil-Fired Malleable Furnace Operates. (82236). Ills. 1200 w. Fndry—Nov. 1917. Advantage lies in uniformity of operation and labor saving.

Polishing

The Polishing Room. (82570). J. F. Springer. Ills. 4000 w. Brs Wld—Nov. 1917. Serial. 1st part. The polishing room of an electroplating plant. Use of the speed lathe, etc.

Rifle-Barrels

Special Automatic Rifle-Barrel Machine. (82569). E. H. Ingram. Ills. 600 w. Am Mach—Nov. 22, 1917. Details of a machine that has increased production several hundred per cent.

Shafting

Making Cold-Drawn Shafting. (82122A). Edward K. Hammond. Ills. 6500 w. Machy—Nov., 1917. Features of practice in its manufacture. It is essentially wiredrawing on a large scale.

Shop Practice

A Railroad Wheel Shop in Nevada. (82318) Frank A. Stanley. Ills. 1500 w. Am Mach—Nov. 8, 1917. Operations on wheels and axles in a shop of the Southern Pacific.

The Use of Lines in Finding the Blank. (82544A). G. W. Smith. Ills. 1500 w. Mech Wld—Nov. 9, 1917. Suggestions for toolmakers employed on press tools.

Sine Bar

Uses of the Sine Bar. (82171) E. J. Bryant. Ills. 1200 w. Am Mach—Nov. 1, 1917. Describes its use in one of the large tool, gauge, and fixture shops.

Sketching

Mechanical Drawing and Sketching for Operating Engineers. (82254). Terrell Croft. Ills 3500 w. Nat'l Engr—Nov., 1917. Serial. 1st part. Directions for making sketches of emergency repair parts.

Taps

Taps and Tapping Equipment (82127A). Franklin D. Jones. Ills 10000 w. Machy—Nov., 1917. Modern developments in design; types of tap-holding chucks.

Tools

Making Oil-Well Tools in California. (82567). Ills. 2500 w Am Mach—Nov. 22, 1917 Manufacture of large pipe tongs described.

Type Bars

Manufacture of Type Bars for a Typewriter (82173). Frank A. Stanley. Ills. 3000 w. Am Mach—Nov 1, 1917. Punching and grinding operations described.

Welding

Useful Data for Spot Welding Work. (82469). Lucien Haas. Ills. 2200 w. Am Mach—Nov. 15, 1917. Details of various operations.

Wire

The History of Wire Manufacture. (82291A). 1500 w. Engr—Oct. 19, 1917. Abstract of address by Jos. Phillips Bedson on developments in this field.

Wire-Drawing. (82682). 1300 w. Times Engng Supp—Oct. 26, 1917. Progress of the industry in England related in address to Manchester Association of Engineers.

Wire Ropes

History of Wire Hoisting Ropes with Notes on Factors of Safety. (82349). 4000 w. Eng & Min Jl—Nov. 10, 1917. Materials used; nature and effect of strains, etc.

Worm-Gearing

Worm-Gearing. (82543A). F. J. Bostock. 1000 w. Mech Wld—Nov. 2, 1917. Serial. 1st part Factors which render the manufacture a precision accomplishment.

MATERIALS OF CONSTRUCTION

Alloys

Alloy Metals, Production and Uses, Especially in Relation to the War. (82188B). George K. Burgess. 1200 w. Jl Ind of Eng Chem—Nov., 1917. Notes on observations made abroad.

Brass Rolling Mill Alloys. (82445F). R. A. Wood. 3000 w. A I Mt, Jl—Sept., 1917. Mixtures and their characteristics.

The Electrical Properties of Some High Resistance Alloys. (82441F). M. A. Hunter and F. M. Sebast. Curves. 2500 w. A I Mt, Jl—Sept, 1917 Investigation of the electrical properties of alloys forming solid solutions.

Metallurgy of Titanium Ferro-alloys. (82604). Robert J. Anderson. 4000 w. Eng & Min Jl—Nov. 24, 1917. Development, evolution, and present practice. Practical suggestions.

Bakelite

Fabricated Bakelite Materials. (82153A). Ray P. Jackson, with discussion. Ills. 3500 w. S A E, Jl—Oct., 1917. Its characteristics and applications.

Machine Tools

Foreign Machine Tool Demands. (82399A). 3500 w. Ry Mech Engr—Nov., 1917. Yearly output of American builders tripled; demand expected to continue after war.

Responsibility of Machine Tool Builders. (82470). Henry Japp. Ills. 3500 w. Am Mach—Nov. 15, 1917. Address by the Deputy Director General in United States for British Minister of Munitions.

Refractories

On the Testing of Refractory Materials. (82140A). J. W. Mellor. Read before the Ceramic Soc., Glasgow. 3000 w. Engng—Oct. 12, 1917. Urges standardization of methods.

Refractories. (82680). 2000 w. Times Engng Supp—Oct. 26, 1917. Increase in demand and output reported by British Ceramic Society.

Refractories and Modern Kilns. (82143A). J. G. Maxwell. Read before the Ceramic Soc., Glasgow. 3000 w. Engng—Oct. 12, 1917. Types of kilns suitable for burning firebricks and fireclay blocks, and types of fuel for firing them.

Sand

Moulding Sand. (82546A). R. Robertson. 1000 w. Mech Wld—Nov. 9, 1917. Essential properties; sands suitable for different kinds of work, etc.

Specifications

Government Specifications for Testing and Inspecting Metallic Materials. (82320). Ills. 2000 w. Am Mach—Nov. 8, 1917. Adopted by the International Aircraft Standards Board, Washington, D. C.

Stellite

Stellite. (82449F). Edward Haynes. 2000 w. A I Mt, Jl—Sept., 1917. An alloy made to resist the oxidizing influences of the atmosphere, and its uses.

MEASUREMENT

Crankshafts

Analysis of Crankshaft Stresses. (82594). Otto M. Burkhardt. Ills. 2500 w. Auto Ind—Nov. 22, 1917. Serial, 1st part. Features of different bearing layout. Effect of number of cylinders.

Flumes

Flow Conditions in Flumes. (82513). John S. Longwell. Curves. 1000 w. Can Engr—Nov. 15, 1917. Shows that where water flows at high velocity investigations should be made before final designs are adopted.

Impact Test

The Impact Test of Materials. (82541A). Howard Ensaw. Ills. 600 w. Mech Wld—Nov. 2, 1917. Suggestions, describing the Stanton machine.

Instruments

Power Plant Instruments as an Investment. (82118). M. A. Saller. 2200 w. Pr Pt Eng—Nov. 1, 1917. Serial, 1st part. When is it advantageous to purchase instruments, showing operating conditions.

Joints

The Shearing Resistance of Nailed Joints. (82410A). Henry F. Blood. 1000 w. Ore Soc Engrs, Jl—Oct., 1917. Tests and results.

Orifice Discharges

Orifice Dicharges for Saturated Steam. (82119). L. A. A. Karl. 900 w. Pr Pt Eng—Nov. 1, 1917. Chart designed to simplify necessary calculations.

Shaft Speeds

The Whirling of Shafts. (82552A). H. A. Webb. 1200 w. Engng—Nov. 2, 1917. Serial, 1st part. The problem of calculating the whirling speed. Mathematical.

Slide Rules

Design of Special Slide Rules. (82638A). A. Lewis Jenkins. Ills. 1500 w. Ind Man—Dec., 1917. Second part of article giving systems and equations for the solution of problems.

Tests

On Testing Materials. (82123A). William Knight. 2500 w. Machy—Nov., 1917. Interpretation of results obtained from various tests.

Textiles

The Moisture Content of Textiles and Some of Its Effects. (82257A). William D. Hartshorne. 4500 w. A S M E, Jl—Nov., 1917. Effects on weight, dimensions, strength and elasticity.

Thermostat

Further Notes on a High-Temperature Thermostat. (82287A). J. L. Haughton and D. Hanson. Read before the Inst. of Metals. Ills. 3200 w. Engng—Oct. 19, 1917. Describes alterations which render the apparatus suitable for temperatures much above 500 deg. C.

POWER AND TRANSMISSION

Air Compressors

Lubrication of Motor-Driven Air Compressors. (82213). Ills. 4500 w. Elec Rev, Chi—Nov. 3, 1917. Requirements of suitable oil; economy in use of oils, etc.

Hotel Equipment

For the Comfort of the Guest. (82396). Ills. 1700 w. Pr Pt Eng—Nov. 15, 1917. Equipment for Hotel Deshler, Columbus, O.

Power-Plant Operation

Improving Power-Plant Operation Through Instruction. (82640A). Herman A. Fisher. 1500 w. Ind Man—Dec., 1917. Appeal for better instruction of employees.

Prime Movers

A Comparison of the Working Costs of the Principal Prime Movers. (82365A). Oswald Wans. From a paper before the Inst. of Mech. Engrs. 1500 w. Mech Wld—Oct. 26, 1917. Serial, 1st part. Gives data for estimating capital expenditures and working costs, and establishing the relative commercial value.

Siberia

Power Development in Russian Asia. (82149). Ludwig W. Schmidt. 2500 w. Power—Oct. 30, 1917. Possibilities of the use of machinery for the application of power in the industries of Siberia.

STEAM ENGINEERING

Bagasse

Bagasse as a Source of Fuel. (82260A). E. C. Freeland. 2500 w. A S M E, Jl—Nov., 1917. Calorific value of this fuel to the sugar industry. Benefits of preliminary drying.

Boilers

The Form of Boiler Drums. (82368). Robert Cramer. Ills. 2000 w. Power—Nov. 13, 1917. The most suitable shapes.

Electric Heat Storage in Boilers. (82554A). Ills. 800 w. Engng—Nov. 2, 1917. Detailed description of the Revel apparatus for generating steam by electricity.

Feed Pumps

Automatic Control for Boiler Feed Pumps. (82527). Ills. 1200 w. Ht & Vt Mag—Nov., 1917. Piping and method of control.

Firing

How to Fire the Down-Draft Smokeless Boiler. (82111). A. Bement. 3000 w. Ht & Vt Mag—Oct., 1917. Important points to consider in obtaining the required efficiency.

Fuels

Symposium on Utilization of Low-Grade Fuels. (82341). Ills. Also editorial. 3500 w. Elec Wld—Nov. 10, 1917. Forms of mine refuse that have been successfully burned. Problems involved.

The Use of Culm and Other Waste Fuels. (82145A). John B. C. Kershaw. 4000 w. Engr—Oct. 12, 1917. Facts based on recent practical trials in England, America and Germany.

Gas-Firing

Principles and Methods of a New System of Gas-Firing. (82146A). A. C. Ionides. Ills. 1500 w. Engr—Oct. 12, 1917. Read before the Inst. of Metals. Explains methods and their advantages

Oil Fuel

Practical Details in Burning Fuel Oil Under Boilers. (82637A). Henry James Kennedy. Ills. 3500 w. Ind Man—Dec., 1917. Reviews methods of employing oil as fuel for steam generation.

Smoke

Controlling Smoking Chimneys. (82689). Ills. 1200 w. Power—Nov. 27, 1917. Efforts of a large power plant to assist in the prevention of smoke.

Smoke Abatement Activities in American Cities (82112). Joseph M. Lonergan, J. W. Henderson and Walter M. Squires. Ills. 3000 w. Ht & Vt Mag—Oct., 1917. Work in New York, Pittsburgh, and Cincinnati.

Smoke—Its Cause, Effect and Remedy (82537 B). Joseph M. Lonergan. Ills. 22 pp. Mun Engrs' Jl—Oct., 1917. States the principal causes, and effects, and the most successful remedies.

Soot

Soot Removal from Boiler Surfaces (82340). Lionel Linnell. 1500 w. Elec Rev, Chi—Nov. 10, 1917. Evils of soot and a comparison of hand and mechanical methods for its removal.

Superheaters

Superheaters—Their Advantages, Installation and Operation (82255). W. A. Taller. Ills. 1700 w. Natl Engr—Nov., 1917. Flooding superheaters, cleaning and care.

Turbines

Sur Les Turbines A Vapeur (82656 B). A. Normier. 3500 w. Industrie Electrique—Oct. 25, 1917. Calculation of turbine efficiencies under various conditions.

Turbo-Blowers

Turbo-Blowers and Turbo-Compressors (82302 N). V. Oswald Davis. Ills. 2500 w. Beama Jl—Oct., 1917. Their advantages, efficiency, etc.

Uniflow

Valve Gear of Uniflow Engines (82117). Ills. 2000 w. Pr Pt Eng—Nov. 1, 1917. Methods employed to operate valves for condensing and non-condensing types.

TRANSPORTING AND CONVEYING

Cranes

Giant Crane for United States Navy (82238 A). Ills. 1000 w. Int Mar Eng—Nov., 1917. 200-ton floating crane for Norfolk navy yard.

Unloaders

L'Installation Pour Le Chargement Du Charbon (82664 B). Ills. 2600 w. Génie Civil—Oct. 20, 1917. Coal conveyors and unloaders on wharf at Durban, South Africa.

MISCELLANY

Mirrors

The Deposition of Silver Films on Glass (82189 B). Alexander Silverman and Raymond M. Howe. 4000 w. Jl Ind & Eng Chem—Nov. 1917. Investigation aiming to produce the best mirrors possible.

Photography

Color and Color Photography (82165 B). C. D. Hodgman, with discussion. 9 pp. Cleve Eng Soc, Jl—Sept., 1917. Present methods and problems involved.

Technical Photography and Its Use in Industrial and Commercial Organizations (82193 B). John H. Graff. 3000 w. Jl Ind & Eng Chem—Nov., 1917. How photography can be used technically for better efficiency and to good advantage.

The Physical Characteristics of the Elementary Grains of a Photographic Plate (82458 B). Millard B. Hodgson. Ills. 10 pp. Fkn Inst, Jl—Nov., 1917. Data obtained in a study.

ELECTRICAL ENGINEERING

COMMUNICATION

Audion

What Happens in an Audion (82612 A). J. B. Will. Ills. 5000 w. U S Nav Inst, Pro—Nov., 1917. Physical characteristics and action explained.

Disturbances

Disturbance of Telegraphic Communication in the Rhone Valley Through the Operation of the Lötschberg Electric Railway (82296 A). M. Dumermuth, in *Elektro. Zeit.* (Abstract translation.) Ills. 900 w. Elec'n—Oct. 26, 1917. Experiments carried out to determine the nature and cause of the disturbances and their removal.

Radiotelegraphy

Internal Relations in Audion-Type Radio Receivers (82293 A). Ralph Bown. Diagrams. 3500 w. Elec'n—Oct. 26, 1917. Experimental curves are shown from which the details of the operation of the audion as a detector are followed.

I Moderni Sistemi di Trasmissione Radiotelegrafica (82650 B). 2000 w. Mon Tecnico—Oct. 10, 1917. Descriptive outline of new system for long distance transmission, employing wave lengths of 6,000 meters.

Research

Industrial Research with Some Notes Concerning Its Scope in the Bell Telephone System (82508 D). F. B. Jewett. 14 pp. A I E E, Pro—Nov., 1917. Outlines the scope and progress.

Signal Corps

Field Signal Corps Battalions (82332). Stanley R. Edwards. Ills. 4000 w. Telephony—Nov. 10, 1917. How men are being prepared for active service.

Specifications

Railroad Crossings (82307 A). 6000 w. Tel Engr—Nov., 1917. Specifications prepared by the Public Service Commission of Pennsylvania.

Telephony

Telephone Development in the World at the Beginning of 1917 (82283 A). W. H. Gunston, in *Telegraph & Telephone Jl.* 500 w. Elec'n—Oct. 19, 1917. An estimate.

ELECTRO-CHEMISTRY

Batteries

High-Potential Batteries for Supplying Small Currents (82281 A). Frank Horton. Abstract from **Phil. Mag.** 1000 w. Elec'n—Oct. 19, 1917. Types used.

Chemical Industry

Organisation of Chemical Industry After the War (82660 A). 1600 w. Nature—Oct. 11, 1917. Conditions to be met in England in chemical industries.

Corrosion

Typical Cases of the Deterioration of Muntz Metal (60:40 Brass) by Selective Corrosion (82443 F). Henry S. Rawdon. Ills. 5500 w. A I Mt, Jl—Sept., 1917. Illustrated by five types, including tubing, sheets, and forgings.

Electrolysis

Preventing Electrolysis of Iron in Concrete (82343). W. A. Del Mar and D. C. Woodbury. Ills. 1200 w. Elec Wld—Nov. 10, 1917. Research indicates that anode corrosion may be decreased by coating metal with a porous film of paint.

Electrometallurgy

Annealing and Heat Treating of Steel and Melting of Non-Ferrous Metals in the Electric Furnace (82162 B). T. F. Bailey, with discussion. 6000 w. Cleve Eng Soc, Jl—Sept., 1917. Some of the uses to which electric furnaces have been applied.

The Electric Furnace as a Medium for Heating Non-Ferrous Metals (82453 F). 34 pp. A I Mt, Jl—Sept., 1917. Advantages by the use of the heat of electric energy in various metallurgical processes.

Electroplating

Addition Agents in Cyanide Solutions (82572). Joseph Haas, Jr. 1500 w. Brs Wld—Nov., 1917. Explains uses to which platers may put sodium potassium, tartrate or Rochelle salt, and sodium citrate to enable them to get uniform deposits from solutions of copper, brass and zinc.

Silver Peroxide and the Valence of Silver (82573). H. C. P. Weber. Ills. 1800 w. Brs Wld—Nov., 1917. Serial, 1st part. Investigations and results.

Nitrogen

How Do the Warring Nations Obtain Their Nitrogen Supply? ([illegible] A). S. [illegible]hkoff. Ills. 7800 w. Met & Chem Eng—Nov. 1, 1917. Article, translated from the Swedish, giving valuable information.

The Fixation of Atmospheric Nitrogen (82131 A). 1800 w. Elec Rev—Oct. 12, 1917. Serial, 1st part. The sources, fixation and oxidization processes, etc.

ELECTRO-PHYSICS

Arc Discharges

Pluimontlading (82052 B). A. Vosmaer. Ills. 3900 w. Ingenieur—Oct. 6, 1917. A study of flaming and brush discharges under different conditions.

Magnetic Circuit

The Magnetic Circuit (82479). Terrell Croft. Ills. 2000 w. Elec Rev, Chi—Nov. 17, 1917. Serial, 1st part. First of a series of five articles giving a simple explanation of the phenomena and laws.

Resistance

Experimental Test of the Wiedemann-Franz Ratio Through a Change of State (82456 B). Edwin F. Northrup and Frank R. Pratt. Ills. 13 pp. Fkn Inst, Jl—Nov., 1917. Investigation to hold approximately true for two typical metals which change in resistance in opposite directions when carried from the solid to the molten state.

Vacuum Tubes

Le Tube A Vide Et Ses Applications (82697 B). R. Raymond. 1800 w. Industrie Electrique—Nov. 10, 1917. Recent developments and applications of varions designs.

GENERATING STATIONS

Central Plant

Power Plant of the St. Joseph Lead Co. (82148). E. L. Broome. Ills. 1600 w. Power—Oct. 30, 1917. New central plant serving several mining properties in southeastern Missouri.

Contracts

Engineering Advice in Making Electric Power Contracts (82636 A). A. Langstaff Johnston, Jr. 1200 w. Ind Man—Dec., 1917. Reviews the varieties of rates and unsatisfactory results.

Electrical Industry

A Recent "Union Electric" Development (82418 A). John Hunter. 1500 w. E Cb St L, Jl—Sept.-Oct., 1917. Outlines main features of development of the Ashley Street Generating Station, St. Louis.

Electric Service

The Modern Conception of Electric Service (82646 B). F. S. Dewey. 5000 w. Iowa Eng Soc, Pro—Feb., 1917. Functions and extent of service, benefits, etc.

Hydro-Electric

Electric Power Back of the New Italian Lines (82338). C. A. Tupper. Ills. 3000 w. Elec Rev, Chi—Nov. 10, 1917. Plants for furnishing hydro-electric power for Italian arsenals.

European Hydro-Electric Installations (82335). Sydney F. Walker. 4000 w. Cl Age—Nov. 10, 1917. Opportunities for the development of water power.

Hydroelectric Power for Fixation of Nitrogen—A War Asset (82609). 2500 w. Elec Rev, Chi—Nov. 24, 1917. Accomplished on a large scale in Norway. Electrical process used.

Laurentide Power Developed After War's Interruption (82588). Map & Ills. 2000 w. Eng News-Rec—Nov. 22, 1917. Interesting features of the development.

Municipal Plant

Water and Electric Current for Poplar Bluff (82116). Ills. 1500 w. Pr Pt Eng—Nov. 1, 1917. Missouri city installs electric generators driven by unaflow engines.

Operating Expenses

Analysis of 1,000-Kw. Plant's Revenue and Expense (82622). 2000 w. Elec Wld—Nov. 24, 1917. Marked effect of prevailing high prices.

Power Supply

Electric Power Supply (82673). 3000 w. Times Engng Supp—Oct. 26. 1917. The future of electric power supply in Great Britian. Technical details, inter-connection, etc.

Rates

Effect of Increased Costs on Central Station Rates (82337). 2500 w. Elec Rev. Chi—Nov 10, 1917. Statistics. Effects of increased costs of fuel, labor and material.

Substations

Inexpensive 33,000-Volt Outdoor Substations (82483). Ills. 1000 w. Elec Wld—Nov. 17, 1917. Two designs worked out by an Illinois Company.

Switchboards

Developments in Switchboard Apparatus (82269 A). Ills. 1500 w. Gen Elec Rev—Nov., 1917. Deals with polyphase induction reverse power relays, and outdoor fuse and disconnecting switch for vertical mounting.

Portable Polyphase Switch Boards (82413 A). F. W. Springer. Ills. 300 w. Eng Ed—Oct., 1917. Boards for pedagogical purposes and their uses.

Water-Powers

Water-Powers and Industrial Development (82207). Leo G. Denis. From 8th Annual Report, 1917, Com. of Conservation, Canada. 4000 w. Can Engr—Nov. 1, 1917. Canadian water-powers and their importance in industrial development.

GENERATORS AND MOTORS

Induction Motors

Reconnecting Induction Motors—For Changes in Phase (82367). A. M. Dudley. Ills. 2500 w. Power—Nov. 13, 1917. Serial, 1st part. Factors affected when the winding of a two-phase motor is reconnected to operate on a three-phase circuit, and vice versa.

Motors

Single-Phase Motors (82120). Gordon Fox. Ills. 2500 w. Pr Pt Eng—Nov. 1, 1917. Serial, 1st part. Theory of operation of types most generally employed.

Voltage

Some Early Voltage Regulators (82523). Leon L. Pollard. Ills. 1400 w. Power—Nov. 20, 1917. Early troubles and their causes.

ILLUMINATION

Battlefields

Battlefield Illumination (82530 B). R. C. Kuldell. Ills. 10 pp. Prof-Mem—Nov.-Dec., 1917. An example of practice in America.

Central Stations

Illuminating Engineering as a Commercial Force (82385 N). O. R. Hogue, C. L. Law, and E. E. Whitehorne. 2500 w. Ill Eng Soc—Nov., 1917. Evidence of its importance and utility in the central station field.

Eye Protection

Eye Protection and Sight Filters (82555 A). 2000 w. Engng—Nov. 2, 1917. Investigations of Dr. E. K. Martin.

Some General Notes on the Protection of Eyesight (82270 A). W. S. Andrews. Ills. 2200 w. Gen Elec Rev—Nov., 1917. Injury from heat rays, and need of guarding, and ultra violet rays.

Gas Industry

The Value of Illuminating Engineering to the Gas Industry (82384 N). Robert French Pierce. 3800 w. Ill Eng Soc—Nov., 1917. Suggestions for improving service.

Glow Lamps

A Technical Specification for Metal Filament Glow Lamps (82294 A). 2000 w. Elec'n—Oct. 26, 1917. Summarizes the technical conditions proposed by the Swiss Union of Electricity Works relating to the sale of glow lamps.

Light

On Preferred Proportions in Combining General and Localized Lighting (82386 N). F. C. Caldwell and W. M. Holmes. 12 pp. Ill Eng Soc—Nov., 1917. Reports test, explaining conditions and giving results.

Lighting Code

Code of Lighting School Buildings (82383 N). Ills. 16 pp. Ill Eng Soc—Aug. 30, 1917. First edition of code, circulated for the dissemination of knowledge.

Radiation

The Visibility of Radiation (82388 N). Prentice Reeves. Ills. 1300 w. Ill Eng Soc—Nov., 1917. Data obtained and apparatus used.

Reflectors

Some Experiments on the Eye with Pendant Opaque Reflectors Differing in Lining, Dimensions and Design (82387 N). C. E. Ferree and Gertrude Rand. Ills. 25 pp. Ill Eng Soc—Nov., 1917. Investigation of pendant reflectors.

Remote Control

The Phantom Circuit Remote Control System (82266 A). H. H. Reeves. Ills. 1800 w. Gen Elec Rev—Nov., 1917. Deals with system for turning on and off groups of street incandescent lamps at a distance.

MEASUREMENT

Alternating Currents

Apparatus for Measuring Very Strong or Very Weak Alternating Currents, with Adjustable Field Magnet (82484). Signor Pestarini. Ills. 2200 w. Elec'n—Nov. 2, 1917. Arrangement comprising a special galvanometer and a static phase transformer fed from an alternating auxiliary source.

Electrostatic Problems

An Experimental Method of Obtaining Solution of Electrostatic Problems with Notes on High-Voltage Bushing Design (82507 D). Chester W. Rice. Ills. 147 pp. A I E E, Pro—Nov., 1917. The electrodynamic method is developed to a high degree of accuracy and applied to the study of high-voltage bushings.

Harmonics

Obtaining Approximate Values of Harmonics (82482). Waldo V. Lyon. 1200 w. Elec Wld—Nov. 17, 1917. Simple method based chiefly on shape of hysteresis loop.

Line Tests

Tests of Iron-Wire Transmission Line (82621). 700 w. Elec Wld—Nov. 24, 1917. Comparison of losses in similar iron-wire and copper-wire lines shows that former type is not advisable on certain classes of lines.

Pyrometers

Pyrometers—Their Construction and Application (82450 F). John P. Goheen. 2500 w. A I Mt, Jl—Sept., 1917. Outlines history of the electric pyrometer, their applications, development, etc.

Speed Indicator

The Squirrel Cage Speed Indicator (82295 A). E. B. Brown. Ills. 1000 w. Elec'n—Oct. 26, 1917. Explains action.

Standards

British Electrical Standards (82672). Charles C. Garrard. 2000 w. Times Engng Supp—Oct. 26, 1917. Need of better coöperation by engineers and manufacturers for safety standards.

POWER APPLICATIONS

Cooking

Some Features in the Design of Domestic Electric Ranges (82267 A). J. L. Shroyer. Ills. 3300 w. Gen Elec Rev—Nov., 1917. Requirements of an electric range, the difficulties met, etc.

Electrical Troubles

Happenings in the Electrical Operating Field (82256). E. C. Parham. 2500 w. Natl Engr—Nov., 1917. Incidents dealing with elevators, motor generator sets, springs, insulated shoes, etc.

Electric Drive

Electric Power for Industrial Operations (82219). C. E. Clewell. Ills. 2000 w. Elec Wld—Nov. 3, 1917. Serial, 1st part. Importance of electric drive in industries where labor constitutes a large part of expense.

Electricity in War

Use of Electricity in the European War (82221). Gustave P. Capart. Ills. 1200 w. Elec Wld—Nov. 3, 1917. Transmission lines indispensable; electric organization, etc.

Furniture Factories

Electricity in Furniture Manufacture (82336). Ills. 1200 w. Elec Rev, Chi—Nov. 10, 1917. Advantages and data on h.p. reqnirements.

Glass

Les Méthodes Electrothermiques De Fabrication Du Verre (82696 B). J. Escard. Ills. 5000 w. Industrie Electrique—Nov. 10, 1917. Electrothermic methods in the manufacture of ordinary and of quartz glass.

Metal Cutting

Metal Cutting with the Electric Arc (82264 A). Graham Kearney. Ills. 2500 w. Gen Elec Rev—Nov., 1917. Observations on a practical application, with recommendations.

Motor Drive

Attitude of Machine-Tool Builders to Motor Drive (82619). C. E. Clewell. Ills. 2200 w. Elec Wld—Nov. 24, 1917. Summarizes opinions of ten typical manufacturers all favorable to electric drive.

Pulleys

Uses of Magnetic Separator Pulleys (82610). Ills. 1200 w. Elec Rev, Chi—Nov. 24, 1917. Construction and operation Examples of applications.

Refrigeration

See same heading under MECHANICAL ENGINEERING, *Heating and Cooling.*

Remodeled Plant

Large Savings in Remodeled Plant of Rockwell Manufacturing Co. (82520). Ills. 2500 w. Power—Nov. 20, 1917. Changing from mechanical to individual motor drive effected an annual saving of $7,440.23.

Rolling Mills

Advantages of Electrified Rolling Mills (82620). William Knight. 3500 w. Elec Wld—Nov. 24, 1917. Considerations to be kept in mind in selecting drive. Useful information on power requirements.

Winding

Electric Winding (82134 A). D. Burns. 2500 w. Elec'n—Oct. 12, 1917. (Slightly abbreviated.) The problem of electric shaft winding; illustrated by example.

TRANSFORMERS

Construction

Some Details of Construction of Large Transformers by the British Westinghouse Co. (82485 A). Ills. 1000 w. Elec'n—Nov. 2, 1917. Serial, 1st part. Detailed descriptions.

Design

Minimum-Cost Method of Transformer Design (82220). B. C. Dennison. Ills. 2000 w. Elec Wld—Nov. 3, 1917. First of two articles applying the method worked out to shell, core, and multiple magnetic circuit-type transformers with uniform and non-uniform flux density.

TRANSMISSION AND DISTRIBUTION

A. C. Circuits

Propagation Sur Une Ligne A Circuit Ouvertt (82698 D). E. Brylinski. 7000 w. Bul Soc Internationale Des Electriciens—Aug.-Sept.-Oct., 1917. Mathematical treatment of the propagation of alternating current on closing circuits of various kinds.

Cables

Copper Wires and Cables (82177). J. J. Keyes. 3500 w. Elec Jl—Nov., 1917. Physical and electrical characteristics, methods of stranding, tests on insulated wires and cables, etc.

Fuses

Open and Enclosed Type Fuses (82280 A). A. B. Eason. Abstract of paper in the *P. O. Elec. Engrs.' Jl.* 3500 w. Elec'n—Oct. 19, 1917. Discusses merits and summarizes investigations relating to their testing and standardization.

High Tension

Phasing Out High-Tension Lines Having Step-Up and Step-Down Transformers (82176). E. C. Stone. 2000 w. Elec Jl—Nov., 1917. Method of testing the polarity and phase relations of lines to be paralleled.

Insulators

Factors Affecting Selection of Insulators (82342). A. O. Austin. Ills. 3500 w. Elec Wld—Nov. 10, 1917. Liability to interruption dependent on size of system; steel structures impose greater strains than wood; nature of load

Lightning Arresters

Direct Current Aluminum Lighting Arrester (82268 A). V. E. Goodwin. Ills. 900 w. Gen Elec Rev—Nov., 1917. Principal application in the protection of street railway equipment.

Relays

Relay Operation on Heavy Short-Circuits (82180). L. N. Crichton. Ills. 1400 w. Elec Jl—Nov., 1917. An analysis of tests made by the Alabama Power Co.

Service Installations

Overhead and Underground Service Installations (82212). Edward B. Meyer. Ills. 3300 w. Elec Rev, Chi—Nov. 3, 1917. Review of present practice with the idea of relieving the streets, as far as possible, of overhead wires.

CIVIL ENGINEERING

BRIDGES

Bridge Work

Bridge Work on the Hannibal Line Cut Off (82472). Ills. 1000 w. Ry Age Gaz—Nov. 16, 1917. Construction of a reservoir required the relocation of a part of the C., St. P., M. & O.

Cantilever

The Harahan Bridge at Memphis, Tennessee (82454 B). Ralph Modjeski. Ills. 16 pp. Fkn Inst, Jl—Nov., 1917. Detailed description of this cantilever crossing the Mississippi.

Concrete

Pennsylvania Specifications for Culverts and Short-Span Concrete Bridges (82249 A). 1500 w. Mun Eng—Nov., 1917. Essential clauses of recently adopted specifications.

Quebec

Erection of the Suspended Span of the Quebec Bridge (82560 A). Ills. 1500 w. Engr—Nov. 2, 1917. Serial, 1st part. Detailed account of this important engineering feat.

The Quebec Bridge (82375 A). Ills. 1300 w. Engng—Oct. 26, 1917. Reviews the history of the bridge and its successful completion.

Roller Lift

Keadby Railway and Highway Scherzer Roller Lift Bridge (82553 A). Ills. & Plates. 6000 w. Engng—Nov. 2, 1917. Serial, 1st part. Details of an interesting bridge having the largest roller lift span yet built.

Salem Bridge

Twenty-four Designs for Salem Bridge Wasted Before Commissioners Agreed (82311). Ills. 1500 w. Eng News-Rec—Nov. 8, 1917. Contract let after three years. Public loses by delay because of rising prices.

Steel

General Specifications for Steel Highway Bridges, Ontario, 1917 (82322). E. H. Darling. 2500 w. Can Engr—Nov. 8, 1917. Analysis of the 1917 specifications showing many changes and improvements.

CONSTRUCTION

Chimneys

Practical Notes on Chimneys and Draft (82114). W. A. Pittsford. Ills. 1200 w. Ht & Vt Mag—Oct., 1917. Data on chimney construction and draft troubles.

Concrete

Large Cold-Storage Building Introduces New Problems in Concrete Design (82425). Ills. 2500 w. Eng News-Rec—Nov. 15, 1917. Complications from division of building into five parts by insulation, which required split columns and intermediate walls.

Construction Camps

The Housing and Feeding of Construction Forces (82576). F. E. Weise. Read before Am. Ry. Bdg. & Bldg. Assn. 2500 w. Eng & Con—Nov. 21, 1917. Suggestions for construction engineers and contractors.

Housing

Industrial Housing (82618 B). Charles C. May. Ills. 3500 w. Archt Forum—Nov., 1917. Notes on the sixth conference of the National Housing Assn.

Scottish Housing (82133 A). 3500 w. Surv'r—Oct. 12, 1917. Royal Commission's report: Drastic recommendations.

The Problem of Industrial Housing (82641 A). Leslie H. Allen. Ills. 3800 w. Ind Man—Dec., 1917. Reviews difficulties and possibilities.

Mill Design

Machinery and Footing Complications Control Mill Design (82314). W. Stuart Tait. Ills. 1500 w. Eng News-Rec—Nov. 8, 1917. Three different kinds of foundations, and other details of interest.

Reinforced Concrete

Brooklyn Naval Storehouse Finished Ahead of Schedule (82586). Ills. 1500 w. Eng News-Rec—Nov. 22, 1917. Eleven-story concrete building frame completed with roof in fourteen weeks.

Roofs

Cast-in-Place Reinforced-Gypsum Roof Slabs on Paper-Mill Buildings (82203). Ills. 900 w. Eng News-Rec—Nov. 1, 1917. New methods developed.

Underpinning

Some Examples of Modern Underpinning (82536 B). Abstracts from paper by Lazarus White and Edmund Astley Prentis, Jr. Ills. 1000 w. Mun Engrs Jl—Oct., 1917. Work under the Bank of America, and the National City Bank, in New York City.

IRRIGATION AND RECLAMATION

Design

Calculations for Design of Irrigation Structures (82515). Charles W. Helmick. Extracts from *Transit*. 800 w. Can Engr—Nov. 15, 1917. Designing headworks, etc.

Drainage

Drainage in the Red River Valley in Manitoba (82323). G. B. McColl. Abstract of paper before Can. Soc. of Civ. Engrs. Ills. 2000 w. Can Engr—Nov. 8, 1917. General principles of drainage and their application to special conditions and difficulties.

MATERIALS OF CONSTRUCTION

Concrete

Frozen Concrete in Floor Slab Has Low Tested Strength (82312). Sanford E. Thompson. Ills. 800 w. Eng News-Rec—Nov. 8, 1917. Shows upper half with frost marks and low strength while lower half is normal.

Prime Factors in Making Concrete (82685 B). R. W. Crum. 1000 w. Iowa Eng Soc, Pro—Feb., 1917. Factors demanded for good quality.

Conservation

The Conservation of Material (82402 A). M. K. Barnum, with discussion. Ills. 26 pp. N Y Rd Cb, Pro—Oct. 19, 1917. Deals with reclamation and preservation and gives examples of work and results.

Ferro-Alloys

New York Section War Meeting on Ferro-Alloys (82497 D). 12 pp. A I M E, Bul—Nov., 1917. Address on "Chrome Mining and Concentration," by C. S. Newcomb, with short addresses by W. B. Driver, S. H. Ball, and G. K. Burgess.

Railway Material

Conservation and Reclamation of Material (82328). M. K. Barnum, with discussion. Read before the N. Y. Ry. Club. 3400 w. Ry Age Gaz—Nov. 9, 1917. Means by which the service of railway material may be increased.

Regulations

Priority Regulations for Railway Materials (82210). 2500 w. Ry Age Gaz—Nov. 2, 1917. System of priority to determine the relative precedence in which orders shall be filled.

Reinforced Concrete

The Deteriorating Action of Salt and Brine on Reinforced Concrete (82457 B). Henry Jermain Maude Creighton. Ills. 16 pp. Fkn Inst, Jl—Nov., 1917. Account of observations and conclusions.

Roofs

The Heat-Insulating Value of Roofing Materials (82285 A). W. M. Thornton. 1200 w. Engng—Oct. 19, 1917. Report of tests.

Sandstones

Test of Some Canadian Sandstones to Determine Their Suitability as Pulpstones (82509 N). L. Heber Cole. Ills. 16 pp. Can Dept Mines—Bul. No. 19. To determine their suitability for use as wood pulp grinders.

Stonework

A Stonework Destroying Fungus (82574 A). James Scott. Ills. 1500 w. Ry Engr—Nov., 1917. Describes species.

Timber Preservation

Field Tests Made on Oil Treatment of Wood Against Marine Borers (82202). C. H. Teasdale and L. F. Shackell. Ills. 3000 w. Eng News-Rec—Nov. 1, 1917. Studies of creosote oil protection on specimens immersed six years indicate need for high boiling oils.

Waterpoofing

Integral Waterproofing for Concrete (82420 A). S. B. and A. C. Newberry and H. C. Morrison. 2500 w. E Cb St L, Jl—Sept.-Oct., 1917. Methods and their value.

MEASUREMENT

Roofings

Analysis and Testing of Prepared Roofings (82192 B). Herbert Abraham. Ills. 4000 w. Jl Ind & Eng Chem—Nov., 1917. Considers prepared roofings manufactured from asphaltic compositions.

MUNICIPAL

Activated Sludge

Conclusions on Activated Sludge Process at Milwaukee (82204). 5500 w. Eng News-Rec—Nov. 1, 1917. T. Chalkley Hatton discusses many features of sewage treatment work.

The Treatment of Packing-house Wastes by Activated Sludge Process (82422). Langdon Pearse. Read before Am. Pub. Health Assn. 2500 w. Eng & Con—Nov. 14, 1917. Summary of experiments and results in Chicago.

City Government

The Commission-Manager Plan of City Government (82648 B). O. E. Klingaman, with short discussion. 5000 w. Iowa Eng Soc, Pro—Feb., 1917. Outlines the proposed plan.

Refuse

Contract Plans and Specifications for Obtaining Refuse Incineration Works on the Most Economical Basis (82248 A). Rudolph Hering. 3000 w. Mun Eng—Nov., 1917. Abstract of an address to the Am. Pub. Health Assn. The interrelation of plant design and operation and refuse collection; guarantees, etc.

Electricity Promotes Economy in Street Refuse Disposal (82339). Ills. 1200 w. Elec Rev, Chi—Nov. 10, 1917. New York City's modern equipment.

The Utilization of Waste Food in Town's Refuse (82511 A). John J. Beckett. 2200 w. Surv'r—Nov. 2, 1917. Explanation of Liverpool methods.

Roofs

Possible Uses of the Flat Roof (82175 B). Raymond M. Robinson. 3500 w. Archt Forum—Oct., 1917. Suggestions and uses already applied.

Sanitation

Economy and Efficiency (82510 A). W. H. Eccles. 1500 w. Surv'r—Nov. 2, 1917. Discusses the prevention of disease; danger from accumulation of decaying organic matter; utilizaton of waste, etc.

Sewage

Disinfection of Sewage by Copper Salts (82424). 1500 w. Eng & Con—Nov. 14, 1917. Investigations by city of New Haven, Conn., to determine upon a method of sewage disposal.

Making Sure of Proper Operating Methods at York, Pa., Sewage Treatment Plant (82247 A). Ills. 3000 w. Mun Eng—Nov., 1917. Details of the plant and its operation.

Sewage and Its Precipitation: Further Experiments (82360 A). Reginald Brown. 3300 w. Surv'r—Oct. 26, 1917. Read before the Soc. of Engrs. 1, Tests with lime only; 2, ferric sulphate (liquid) and lime; 3, sulphate of alumina and lime.

Sewage Disposal

An Unusual Automatic Pumping Station (82478). G. R. Radley. Ills. 1500 w. Elec Rev, Chi—Nov. 17, 1917. Control equipment of sewage-disposal plant at South Pasadena, Cal.

Screens, Filters and Humus Tanks for Indianapolis (82587). 2500 w. Eng News-Rec—Nov. 22, 1917. Imhoff and sprinkling filters, and activated sludge process eliminated.

Sewage Disposal Problems of a Coast Summer Resort (82625 B). William Eustis Brown. 2500 w. Am Jl Pub Hh—Nov., 1917. Sanitary progress and problems.

Submerged Pipe

Flexible-Joint Precast Concrete Pipe Laid Below Water in Lake Erie (82309). Ills. 1200 w. Eng News-Rec—Nov. 8, 1917. Details of work at Lakewood, Ohio, and at Cleveland in constructing outfall sewers.

War Effects

The Effect of the War on Municipal Engineering and Public Health (82361 A). H. Percy Boulnois. 3000 w. Surv'r—Oct. 26, 1917. Serial, 1st part. Bearing of municipal engineering on public health; suspended contracts; matters effected, etc.

ROADS AND PAVEMENTS

Brick

Tests Show Advantages of Laying Brick Directly on Concrete Base (82200). C. C. Wiley. Ills. 2500 w. Eng News-Rec—Nov. 1, 1917. Research shows that such a slab is the same as that of an equal thickness of concrete.

The Comparative Merits of Wire-Cut Lug and Repressed Brick (82649 B). Jas. C. Traville. 2000 w. Iowa Eng Soc, Pro—Feb., 1917. Their use as a paving material. Important features of wire-cut lug brick.

British Roads

War's Influence on British Road Work Discussed in Report (82310). 2500 w. Eng News-Rec—Nov. 8, 1917. Heavy motor traffic has damaged highways; much reconstruction after the war.

Concrete

Concrete Highway Construction in Contra Costa Country (82353). Ills. 1500 w. West Eng—Nov., 1917. Concrete without asphaltic surface.

Concrete Roads in Wood County, West Virginia (82356). Burdette Woodyard. 4000 w. Br Rds & Sts—Nov., 1917. Conditions and experience.

Construction

Considerations Governing the Choice of Various Types of Road Construction (82275). 1800 w. Eng & Con—Nov. 7, 1917. Abstract of L. V. Edwards paper at meeting in State of Washington. Factors controlling the selection.

Highway Survey

Methods Employed by the Wisconsin Highway Commission in Making Condition Survey of State Trunk Highways (82274). A. R. Hirst. 1200 w. Eng & Con—Nov. 7, 1917. System devised to give required information for coöperation of the State with the Federal Government.

Macadam

Clinker Asphaltic Macadam, Hounslow (82132 A). J. G. Carey. 2500 w. Surv'r—Oct. 5, 1917. Describes resurfacing work, and gives report of inspection.

Mexico

Road Work on the Punitive Expedition into Mexico (82529 B). Ernest Graves. Ills. 25 pp. Prof-Mem—Nov.-Dec., 1917. Problems encountered and methods used.

Military Roads

Military Roads on the Island of Oahu (82528 B). William E. R. Covell. Ills. 14 pp. Prof-Mem—Nov.-Dec., 1917. Military road systems and their application to this Hawaiian island.

Pavements

A Report on the Cost of Pavements (82411 A). 1500 w. Ore Soc Engrs, Jl—Oct., 1917. Deals with cost of constructing pavements in Portland, and throughout Oregon.

Hard-Surface Pavements for State Highways (82582). Charles J. Bennett. Ills. 2000 w. Eng News-Rec—Nov. 22, 1917. Systems designed for heavy motor traffic.

Road Survey

Speedy Road Condition Survey by Auto Cost Only $1.20 per Mile (82426). 1500 w. Eng News-Rec—Nov. 15, 1917. Wisconsin Highway Commission collects data on 7,500 miles of road.

Sand Roads

Experiment of Wisconsin Highway Commission in Improvement of Sand Roads by Hay and Tar Mats (82273). H. J. Kuelling. Ills. 1300 w. Eng & Con—Nov. 7, 1917. Construction of experimental road.

Southern Roads

Comprehensive Good Roads Construction Would Enormously Benefit the South (82303). Henry Roberts. 1500 w. Mfrs' Rec—Nov. 8, 1917. Explains the needs and benefits to be expected.

Texas Roads

Hard Pavements Are Replacing Dusty Adobe Roads in Western Texas (82427). Ills. 2200 w. Eng News-Rec—Nov. 15, 1917. Report of El Paso County's 50-mile system.

WATER SUPPLY

Analysis

A Sanitary Interpretation of Water Analysis (82166 B). E. C. Richardson. 2800 w. Cleve Eng Soc, Jl—Sept., 1917. Bacteriological and chemical analysis and the maintenance of wholesome water supply.

Cantonments

Solving the Water Supply and Sewerage Problems at the Camp Pike Cantonment (82243 A). E. B. Black. Ills. 1000 w. Mun Eng—Nov., 1917. Near Little Rock, Ark.

Consumption

Report of the Joint Committee on Water Consumption (82437 D). 1000 w. N E Wr Wks Assn, Jl—Sept., 1917. On standard form for statistics.

Clinton, Iowa

A Presentation of Estimates and Rates of a Proposed Water Works System for the City of Clinton, Iowa (82647 B). J. G. Thorne, with short discussion. 6500 w. Iowa Eng Soc, Pro—Feb., 1917. Plans and cost for four alternate systems, with annual cost and rates required.

Dams

Construction Plant and Methods Employed in Building the Nepaug Dam of the Hartford Water Works (82245 A). H. W. Griswold. 1800 w. Mun Eng—Nov., 1917. Details of the work, with cost.

The Effect of Intensive Water on the Stability of a Masonry Dam (82373 A). A. A. Stoddard. Ills. 2500 w. Engng—Oct. 26, 1917. Examines hypotheses and theories aiming to show the possible action and its bearing on the design.

The Mountain Dell Dam (82626 A). Sylvester Q. Cannon. Ills. 1000 w. Utah Soc Engrs, Mthly Jl—Sept., 1917. Details of reservoir for storage of water for supply of Salt Lake City.

Filtration

Filtration Plant at Aylmer, P. Q. (82206). H. Llewellyn Seymour. Ills. 3500 w. Can Engr—Nov. 1, 1917. Read before Can. Soc. of Civ. Engrs. Crushed marble mixed with silica sand as filtering medium in gravity type mechanical plant.

Mechanical Filter Bottoms and Strainer Systems (82436 D). Robert Spurr Weston. 2200 w. N E Wr Wks, Jl—Sept., 1917. Describes types, and difficulties.

Rapid Sand Filtration (82435 D). George A. Johnson, with discussion. 83 pp. N E Wr Wks Assn, Jl—Sept., 1917. Reviews growth of filtration in North America, giving statistics, systems, etc.

Manganese Removal

Removal of Manganese from Water Supplies (82423). H. P. Corson. 3500 w. Eng & Con—Nov. 14, 1917. Abstract of thesis outlining methods developed.

Meters

The Results of the Use of Meters in the Metropolitan Water District, Boston (82440 D). Samuel E. Killam, with discussion. 16 pp. N E Wr Wks Assn, Jl—Sept., 1917. Metered service and its success in stopping waste.

Pipes

Experiences with Universal Cast-Iron Pipe (82430 D). John H. Walsh, with discussion. 1500 w. N E Wr Wks Assn, Jl—Sept., 1917. Favorable report.

Report of Committee on Service Pipes (82434 D). With discussion. 67 pp. N E Wr Wks Assn, Jl—Sept., 1917 Deals with materials, life, size, cleaning, etc.

Public Utilities

Procedure in Management and Operation of McPherson, Kans., Water and Electric Plant (82246 A). Arthur Groesbeck. 1800 w. Mun Eng—Nov., 1917. Reorganization, operating conditions, improvements, etc.

Reservoirs

Cableway Handles Relining of Cleveland Water Basin (82584). Ills. 1500 w. Eng News-Rec—Nov. 22, 1917. Reservoir reinforced with 18,000 yards of concrete placed without erecting construction plant on roof.

Design and Construction of 1,500,000-Gallon Reinforced Concrete Reservoir (82244 A). H. F. Blomquist. Ills. [illegible]000 w. Mun Eng—Nov., 1917. Deals with special features of design and methods of construction.

St Paul Concrete Reservoir Has Unique Side-Wall Design (82428). W. N. Jones. Ills. 2000 w. Eng News-Rec—Nov. 15, 1917. Hollow gravity wall section similar to that used in dam.

Siam

Les Installations Du Service D'Eau Potable (82699 B). L. R. De La Mabotière. 4800 w. Génie Civil—Nov. 10. 1917. New water treating plant for the city of Bangkok. Siatn.

Trenching Machine

Some Experiences With a Trenching Machine (82438 D). George W. Batchelder. 1200 w. N E Wr Wks, Jl—Sept., 1917. Reports work of an Austin machine in Worcester, Mass.

Wells

The New Artesian Well at Stuart, Iowa (82645 B). F. A. Drasda, with short discussion. 1500 w. Iowa Eng Soc, Pro—Feb., 1917. Account of well—3021 ft. deep, the geological formation, etc.

Unsanding Two Deep Wells (82201). W. C. Hammatt. Ills 1200 w. Eng News-Rec—Nov. 1, 1917. Expedients necessaryto remedy faults in drilling.

WATERWAYS AND HARBORS

Dredge

Sea-Going Hydraulic Hopper Dredge for North Pacific Bars (82313). George E. Tonney. Ills. 1300 w. Eng News-Rec—Nov. 8, 1917. Specially designed for heavy work on coast of Washington, Oregon, and California.

French Sea Ports

Les Ports Maritimes I. (82655 B). Ills. 3100 w. La Nature—Oct. 0, 1917. Channel ports, especially Havre.

Holland

De Verbetering en Mitbreiding van de Haven van Delfzijl (82651 B). P. H. Kemper. Insert plate. 3900 w. Ingenieur—Sept. 22, 1917. Report of Commission on Improvement of the harbor of Dalfzijl.

Italy

Le Réseau Navigable De Milan A. L'Adriatique (82666 B). A. Goupil. Ills. 2500 w. Génie Civil—Oct. 20, 1917. Interior waterway from Milan to the Adriatic by a proposed canal and the Po River.

Rivers

Improvements at the St. Maurice River Outlet—Western Branch (82617). Romeo Morrissette. Ills. 500 w. Can Engr—Nov. 22, 1917. Details of work.

St. Lawrence

Notes Upon Survey and Investigation of St. Lawrence River Rapids (82496 A). Albert B. Cudebec. Map & Ills. 15 pp. Corn C E—Oct., 1917. Methods of work.

Switzerland

Der Basler Rheinhafen bei Kleinhüningen (82653 B). Ills. 2100 w. Schweizerische Bauzeitung—Oct. 20. 1917. Improvement of the Rhine waterfront at Basle. New railway terminals, docks, etc.

MISCELLANY

Trench Fighting

Organization and Duties for Trench Fighting (82532 B). O. N. Solbert and George Bertrand. Ills. 50 pp. Prof-Mem—Nov.-Dec., 1917. Fortifications; organization, etc.

MARINE AND NAVAL ENGINEERING

Docks

Commercial Dock Developments at Falmouth (82557 A). 1000 w. Engr—Nov. 2, 1917. Schemes for harbor improvement.

Engineers' Duties

Duties of Newly-Trained Marine Engineers on Merchant Vessels (82240 A). C. H. Willey. 3000 w. Int Mar Eng—Nov., 1917. Serial, 1st part. Service routine explained.

Gunboats

The Tigris Flotilla of Gunboats (82372 A). Ills. 1700 w. Engng—Oct. 26, 1917. Details of design and construction of these vessels of the "Fly" class—16 vessels built in six months.

Hospital Ships

Motor Hospital Ships for the Mesopotamia Expedition (82286 A). Ills. & Plates. 2000 w. Engng—Oct. 19, 1917. Latest hospital ships constructed for the Tigris river.

Labor

Hours of Labor (82671). 1500 w. Times Engng Supp—Oct. 26, 1917. Discussion of question of reduction of hours of labor in British shipyards.

Marine Engineering

The Trend in Marine Engineering (82239 A). C. R. Bruce. From a paper before the Greenock Assn. of Engrs. & Shipbldrs. 2500 w. Int Mar Eng—Nov, 1917. Turbine development and adoption of speed reduction gearing, etc.

Oil Engines

Direct Reversible Marine Oil Engine (82241 A). Ills. 1200 w. Int Mar Eng—Nov., 1917. Three-cylinder type of from 75 to 500 brake horse-power.

Oil Tanker

Standard Oil Tanker Benjamin Brewster (82237 A). Ills. & Plates. 600 w. Int Mar Eng—Nov., 1917. Details of construction and machinery.

Pneumatic Tools

Use and Care of Pneumatic Tools for Shipyards (82242 A). Glenn B. Harris. 1800 w. Int Mar Eng—Nov., 1917. Use and proper handling.

Salvage

A New Device for Raising Sunken Ships (82561 A). Ills. 600 w. Engr—Nov. 2, 1917. Describes a diving globe for salving sunken vessels.

Shipbuilding

The War's Effect on Merchant Shipbuilding (82276 A). Homer L. Ferguson. 7500 w. E Cb Phila, Jl—Nov., 1917. What is being accomplished; types of ships. and problems related.

Coping with War's Demand for Ships (82707 A). Homer L. Ferguson. 5000 w. Mar Rev—Dec., 1917. War problems confronting American shipbuilders.

Ship Design

Saving Steel in Ships (82676). 1700 w. Times Eng Supp—Oct 26, 1917. Work accomplished by the British Load Line Committee in adapting designs to war requirements.

Ship Handling

Notes on Ship Handling (82613 A). G. H. Burrage. Ills. 800 w. U S Nav Inst, Pro—Nov., 1917. A method of finding the course from one relative position to another, knowing the course and speed of the guide, using Martin's mooring board.

Stabilizers

See same heading under Mechanical Engineering, Aeronautics.

Submarines

The Submarine and Kindred Problems (82288 A). 3000 w. Engr—Oct. 19, 1917. From circular issued by U. S. Naval Consulting Board pointing out certain principles misunderstood by laymen.

The Submarine (82927 A). C. H. Bedell. Ills. 28 pp. A S M E—Dec., 1917. History, development, equipment, etc.

U. S. Navy

The Navy and Its Health Problems (82624 B). William C. Braisted. 3000 w. Am Jl Pub Hh—Nov., 1917. Reviews the improvements in hygienic conditons and the results, and needs yet unaccomplished.

The New American Naval Programme (82559 A). 2500 w. Engr—Nov. 2, 1917. Discusses the elements of American designs and equipment.

MINING AND METALLURGY

BASE METALLURGY

Bag Houses

An Automatic Filter at Depue (82502 D). G. S. Brooks and L. G. Duncan. Ills. 1000 w. A I M E, Bul—Nov., 1917. Describes gas-filtering apparatus for removal of dust from crushing and milling plants.

Central States

Silver, Copper, Lead, and Zinc in the Central States in 1916 (82494 N). J. P. Dunlop and B. S. Butler. 105 pp. U S Geol Surv, I:4—Oct. 27, 1917. Statistics of production.

Copper

Collahuasi La Grande Copper Mines, Tarapaca Province, Chile (82603). Paul T. Bruhl. Ills. 2500 w. Eng & Min Jl—Nov. 24, 1917. Details of mineral formation, methods of operation, and climatic conditions.

Copper Refining

The Furnace Refining of Copper (82430 A). Lawrence Addicks. 7500 w. Met & Chem Eng—Nov. 15, 1917. Details of the various operations and influencing factors.

Hydro-Metallurgy

Hydro-Metallurgy of Copper Sulphides (82535). A. E. Drucker. Ills. 1800 w. Min & Sci Pr—Nov. 17, 1917. Treatment of copper-concentrate at the mines.

Ore Deposits

Principles Governing Zinc-Ore Deposits (82216). Frank L. Nason. 3000 W. Min & Sci Pr—Nov. 3, 1917. Effect observed on fissures, contacts between sedimentaries and eruptives, etc., in relation to the origin and genesis of zinc ores.

Zinc

Zinc Refining (82500 D). Leland E. Wemple. Ills. 14 pp. A I M E, Bul—Nov., 1917. Methods of preventing contamination and methods of refining.

COAL AND COKE

Brickwork

Safe Compressive Stresses on Colliery Brickwork (82371 A). W. C. Popplewell. 2500 w. Colly Gdn—Oct. 26, 1917. Data obtained in tests.

British Columbia

Coal in British Columbia (82577). E. Jacobs. 4500 w. Can Min Jl—Nov. 15, 1917. Review of the coal production and deposits.

By-Products

Coal By-Products and the War (82419 A). A. S. Knowles. 3500 w. E Cb St L, Jl—Sept.-Oct., 1917. The coal supply and the industries depending on it.

Caging

Caging Arrangements at Deep Mines (82481). Roland Gascoyne. 1800 w. Cl Age—Nov. 17, 1917. Devices for hoisting more than one car at a time.

Coal

The Coal Problem (82289 A). 2000 w. Engr—Oct. 19, 1917. The situation in Great Britain.

Theories Modernes Sur La Constitution Chimique Des Houilles (82665 B). 5200 w. Génie Civil—Oct. 20, 1917. Serial, 1st part. Modern theories of chemical combination in coal of varous grades.

L'Utilisation Rationnelle Du Charbon En Allemagne (82669 B). R. Schmutz. Ills. 5400 w. Génie Civil—Nov. 3, 1917. The utilization of coal in Germany and the complete gasification of solid combustible.

Coal Gas

See same heading under Mechanical Engineering, Automobiles.

Coal Measures

Geological Structure of the Forest of Dean (82550 A). T. Franklin Sibly. 2000 w. Colly Gdn—Nov. 2, 1917. Geological study of the coal measures.

Coal Sales

Directions as to the Sale of Coal (82284 A). 2500 w. Colly Gdn—Oct. 19, 1917. Amendments made to the directions as to the sale of coal in the United Kingdom

Coal Storage

Coal Storage Basin at Duquesne Lighting Plant (82366). Ills. 1000 w. Power—Nov. 13, 1917. Large reinforced concrete storage basin recently completed at the Brunots Island Power Plant.

Coal Trade

Problems Confronting the Coal Trade (82581). F. B. Hubbell. 2500 w. Mfrs' Rec—Nov. 22, 1917. Outlines history of coal mining in the United States, and calls attention to mistakes made.

Coking

Recent Advances in By-Product Coking in the United Kingdom (82605). J. B. C. Kershaw. 3000 w. Cl Age—Nov. 24, 1917. By-product coking stimulated by war. Benzol and toluol chief source of profit.

Coke Ovens

New Coke Ovens and By-Product Plant at Bearpark Brancepeth Colliery, Durham (82147 A). Ills. 1500 w. Ir & Cl Trds Rev—Oct. 12, 1917. Ovens of the Simon-Carves latest type horizontal-flued waste-heat design. Details of installation.

Cutter Bits

Care and Maintenance of Cutter Bits (82334). Adolf F. Fors. 1500 w. Cl Age—Nov. 10, 1917. Sharp bits essential; correctly formed bits suited to conditions; tempering.

Dyes

A Permanent American Dyestuff Industry (82432 A). H. Gardner McKerrow. Address before Nat. Assn. of Cotton Mfrs. 4000 w. Met & Chem Eng—Nov. 15, 1917. Facts on the development of this industry, with a plea for support.

Economies

Economies in Colliery Electrical Plant (82563 A). H. A. McGuffie. Ills. 4000 w. Ir & Cl Trds Rev—Nov. 2, 1917. Points that would improve the efficiency in many Scottish mines. Presidential address.

Fuel

Coal Mining in the United Kingdom Under War Conditions (82480). J. B. C. Kershaw. 2500 w. Cl Age—Nov. 17, 1917. Steps taken in England to minimize the difficulties arising from fuel shortage.

National Fuel Research (82678). 2700 w. Times Engng Supp—Oct. 26, 1917. Report of Fuel Research Board in Great Britain.

Address on the Fuel Problem in the United States (82465 D). F. C. Honnold, with discussion. 8 pp. Am Soc Ht & Vt Engrs, Jl—Oct., 1917. The coal situation.

Fuel Research (82282 A). 2500 w. Elec'n—Oct. 19, 1917. Abstract of second report of the Fuel Research Board.

Gas Tar

Increasing Gas Tar Production (82674). 2000 w. Times Engng Supp—Oct. 26, 1917. A revised policy and suggestions offered for increasing output.

India

Coal Mining in India in 1916 (82540 A). 2000 w. Colly Gdn—Nov. 2, 1917. Information from the recent report of G. F. Adams, Inspector of Mines in India.

Lignite

L'Industrie Du Lignite (82667 B). L. Renié. Ills. 4000 w. La Nature—Nov. 3, 1917. Lignite in France and its use in briquettes. Distillation products, etc.

Mining Control

Coal Mines Control Agreement (82547 A). 5500 w. Colly Gdn—Nov. 2, 1917. Text of the Compensation Bill introduced in the House of Commons on Oct. 25, with the Agreement to which the Bill is to give effect.

Oxidation

Effect of Low-Temperature Oxidation on the Hydrogen in Coal and the Change in Weights of Coal on Drying. (82379). S. H. Katz and H. C. Porter. Ills. 2500 w. U S Bur Mines—Tech. paper 98 Investigations and results.

Peat

The Peat Deposits of Minnesota (82406 B). E. K. Soper. Ills. 15 pp. Ec Geol—Sept., 1917. Quantity, quality, and uses are outlined.

The Possibilities of Peat as Fuel (82521). John Olsen. 1500 w. Power—Nov. 20, 1917. Method of preparing, use, and cost.

Pit Props

Ferro-Concrete Pit Props (82137 A) W. Marriott. Read before the Midland Co.'s Instn. of Engrs. 1200 w. Colly Gdn—Oct. 12, 1917. Information based on experiments.

Pulverized Coal

Use of Pulverized Coal in Brazil (82400 A). Ills. 1000 w. Ry Mech Engr—Nov., 1917. Method has made available quantities of Brazilian fuel for railroad purposes.

Soft Coal

See same heading under MECHANICAL ENGINEERING, *Heating and Cooling.*

Sulphur

Recovery of Sulphur from Illinois Coals (82431 A). Joseph E. Pogue. 1500 w. Met & Chem Eng—Nov. 15, 1917. Source of increased supply of sulphur.

Recovering Sulphur from Coal (82136 A). From an article by A. Sander, in *Chem. Zeit.* 2000 w. Colly Gdn —Oct. 12, 1917. Diagram and details of the Feld process.

Thin Seams

The Thin Seam Problem (82138 A). H. O. Dixon. Read before Manchester Geol. & Min. Soc. 1500 w. Colly Gdn—Oct. 12, 1917. Methods of cooking and results from a 19-in. seam of steam coal.

GEOLOGY

Nitrates

Origin of Nitrates in Cliffs and Ledges (82350). Hoyt S. Gale. Ills. 2000 w. Min & Sci Pr—Nov. 10, 1917. Deposits formed on Cliffs as well as in soils; meteorological influences, etc.

Oil-Shale

Oil-Shale in the United States (82404 B). Dean E. Winchester. Ills. 13 pp. Ec Geol—Sept., 1917. The formations, origin, their development, processes, results, etc.

Oklahoma Oil

Age of the Oil in Southern Oklahoma Fields (82504 D). Sidney Powers. Maps. 12 pp. A I M E, Bul—Nov., 1917. Geological history and study, with conclusions.

Ore Deposits

Preliminary Note on the Occurrence of Chalmersite, $Cu Fe_2 S_3$, in the Ore Deposits of Prince William Sound, Alaska (82405 B). Bertrand L. Johnson. 1500 w. Ec Geol —Sept., 1917. Physical and chemical properties, distribution, geologic occurrence, etc.

Ores

The Relation of Sphalerite to Other Sulphides in Ores (82501 D). L. P. Teas. Ills. 15 pp. A I M E, Bul—Nov., 1917. Investigations and results.

Survey

Geological Survey in 1916 (82562 A). 4400 w. Ir & Cl Trds Rev—Nov. 2, 1917. Summary of progress.

Volatile Agents

Genetic Classification of Underground Volatile Agents (82403 B). Reginald A. Daly. 20 pp. Ec Geol—Sept, 1917. Critical discussion of technical terms used by geologist, and the need of classification. Suggests a scheme.

IRON AND STEEL

Canada

Notes on the Future of Iron and Steel Trade in Canada (82391 N). W. G. Dauncey. 1500 w. Can Min Inst, Bul—Nov., 1917. Problems and future outlook.

The Production of Iron and Steel in Canada During the Calendar Year 1916 (82382 N). John McLeish. 50 pp. Can Dept Mines—No. 458. Advance chapter of annual report.

Gas Cleaning

A New Blast Furnace Gas-Cleaning Machine (82433 A). John Ruddiman. Ills. 3000 w. Met & Chem Eng—Nov. 15, 1917. Detailed description of machine having interesting features for iron and steel blast-furnaces.

Grain-Size

Grain-Size Inheritance in Iron and Carbon Steel (82499 D). Zay Jeffries. Ills. 16 pp. A I M E, Bul—Nov., 1917. Brief discussion of Prof. Howe's paper on The Supposed Reversal of Inheritance of Ferrite Grain Size from that of Austenite. Also general subject of grain refining in steel and iron.

Malleable Iron

How Malleable Iron Has Improved (82231) Enrique Touceda. Read at Boston meeting of Am. Fndry. Assn. 1500 w. Fndry—Nov., 1917. Outlines progress made recently.

Pulverized Coal for Melting Malleable Iron (82232). W. R. Bean. 2200 w. Fndry—Nov., 1917. Tests showing advantages for powdered fuel.

Widening Fields for Malleable Iron (82272 A). 3000 w. Iron Age—Nov. 8, 1917. Speakers at Am. Ir. & St. Inst. predict greater use.

Iron & Steel

Iron Ore Production and Iron and Steel Making Capacity in the United States (82199). 2000 w. Eng & Con—Oct. 31, 1917. Information concerning iron and steel products; production and consumption.

Iron Atoms

The Experiences of an Iron Atom (82163 B). Charles R. Sturdevant. 19 pp. Cleve Eng Soc, Jl—Sept., 1917. The cycle of changes through which an atom passes.

Minerals

Manganiferous Iron Ores (82492). E. C. Harder. 12 pp. U S Geol Surv—Bul. 666-EE. Reports from various districts, and ways manganiferous ores may be utilized.

Steel

Iron and Steel Men Unitedly Back the Nation (82198). Elbert H. Gary. 3300 w. Mfrs' Rec—Nov. 1, 1917. Address at meeting of Am. Ir. & St. Inst., Cincinnati, O.

Steel Plant

Plant of the Wickwire Steel Co (82271 A). Ills. 700 w. Iron Age—Nov. 8, 1917. Open hearth plant and rolling-mill machinery for producing wire, nails and tacks. Features of interest.

The Corrigan, McKinney New Steel Plant (82429 A). Ills. 5000 w. Iron Age—Nov. 15, 1917. Works including open-hearth furnaces, mills for producing sheet bars, billets and slabs.

MINE OPERATION

Central Plant

Power Plant of the St. Joseph Lead Co. (82517). E. L. Broome. Ills. 2000 w. Eng & Min Jl—Nov. 17, 1917. New central power plant in Missouri, serving several mines.

Drift-Mining

Drift-Mining in California (82516). J. D. Hubbard. Ills. 2500 w. Eng & Min Jl—Nov. 17, 1917. Methods applied to California buried gravel beds.

Electrolysis

Electrolysis Underground in Mines (82551 A). 2200 w. Colly Gdn—Nov. 2, 1917. Cases under the writer's notice; methods of distribution underground, etc.

Government Operation

Government Operation of Mines (82345). Frederick F. Sharpless. 1000 w. Eng & Min Jl—Nov. 3, 1917. Conscripted industry needed.

Methods

Incline Top-Slicing Method (82505 D). W. G. Scott. Ills. 10 pp. A I M E, Bul—Nov., 1917. Suggestions for the application of the Coronado method to ore bodies of larger size.

Mine Lamps

Approved Electric Lamps for Miners (82590 A). H. H. Clark and L. C. Ilsley. Ills. 50 pp. U S Bur Mines—Bul. 131. Describes development of a number of types that meet requirements and discusses features and qualities.

Mine Power

Reconstruction of Hydraulic-Power Canal for Ecuador Gold Mine (82347). Paul C. Schraps. Ills. 3500 w. Eng & Min Jl—Nov. 10, 1917. Details of construction of a new concrete canal delivering water to Pelton wheels at the S. A. Development Co.'s properties in Ecuador.

Mine Shops

Coal Mine Shop Equipment (82214). R. M. Magraw. Ills. 3500 w. Cl Age—Nov. 3, 1917. Advocates facilities for making repairs promptly as needed.

Ore Storage

Yard and Bins for Large Ore Storage Plant (82579 A). Ills. 1000 w. Iron Age—Nov. 22, 1917. Plant at Youngstown, Ohio.

Shafts

Employment of Divers in Shaft Sinking (82548 A). H. Grahn, in *Glückauf.* Ills. 2200 w. Colly Gdn—Nov. 2, 1917. Operations performed by divers.

South Africa

State Operation of Mines in South Africa (82518). A. Cooper Key. 2500 w. Eng & Min Jl—Nov. 17, 1917. Excerpts from the majority report of the Commission of State Mining of South Africa. Unfavorable to general mining. Possible exception of diamond mining.

MINES AND DISTRICTS

Alaska

Gold, Silver, Copper, and Lead in Alaska in 1916. (82688 N). Alfred H. Brooks. 16 pp. U S Geol Surv, I:6—Nov. 20, 1917. Production, with review by regions.

The Alaskan Mining Industry in 1916 (82534 N). Alfred H. Brooks. Ills. & Maps. 62 pp. U S Geol Surv—Bul. 662-A. Results achieved during the year.

California

Mines and Mineral Resources of the Counties of Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura (82491 N). Walter W. Bradley, Emile Huguenin, C. A. Logan, and Clarence A. Waring. Maps & Ills. 175 pp. Calif State Min Bur—Dec., 1916. Developed and undeveloped resources.

Mines and Mineral Resources of San Bernardino County, and Tulare County (82490 N). H. C. Cloudman, Emile Huguenin, F. J. H. Merrill and W. Burling Tucker. Ills. 180 pp. Calif State Min Bur—Dec., 1916. Reports of active and promising properties.

Mines and Mineral Resources of Alpine County, Inyo County, Mono County (82489 N). Arthur S. Eakle, Emile Huguenin, R. P. McLaughlin, and Clarence A. Waring. Ills. 170 pp. Calif State Min Bur—Dec., 1916. Mining under difficulties.

Mines and Mineral Resources of Los Angeles County, Orange County, Riverside County (82488 N). Frederick J. H. Merrill. Ills. 127 pp. Calif State Min Bur—Dec., 1916. Important producers of structural materials and petroleum.

Mines and Mineral Resources of the Counties of El Dorado, Placer, Sacramento, Yuba (92487 N). W. Burling Tucker and Clarence A. Waring. Maps & Ills. 188 pp. Calif State Min Bur—Dec., 1916. Directing of mines in these counties.

Mines and Mineral Resources of the Counties of Butte, Lassen, Modoc, Sutter, and Tehama (82486 N). W. Burling Tucker and Clarence A. Waring. Ills. 86 pp. Calif State Min Bur—Dec., 1916. Mineral properties both active and prospective.

Oklahoma

Lead and Zinc Rival Crude Oil as Fortune Builders in Oklahoma (82580). C. M. Sarchet. 1200 w. Mfrs' Rec—Nov. 22, 1917. Report of production and interesting features of this district.

MINOR MINERALS

Aluminum

See Bauxite.

Antimony

Production of Electrolytic Antimony from Impure Ores (82346). William A. Burr. Ills. 1500 w. Eng & Min Jl—Nov. 3, 1917. Details of Method developed.

Barytes

South's Barytes Industry Expands 400 per cent. Making Nation Practically Independent (82305). James M. Hill. 3000 w. Mfrs' Rec—Nov. 8, 1917. Reviews the remarkable growth of the industry since 1913.

Bauxite

Bauxite and Aluminum in 1916 (82495 N). James M. Hill. 11 pp. U S Geol Surv, I:5—Nov. 2, 1917. Production, prices, U. S. deposits, etc.

Chromite

Chromite in 1916 (82493 N). J. S. Diller. 17 pp. U S Geol Surv, I:2—Oct. 26, 1917. Composition, production, prices, imports, etc.

Nitrates

"Until Further Need Arises"—The Nitrate Problem (82197). Frank S. Washburn. 4000 w. Mfrs' Rec—Nov. 1, 1917. Reviews the situation in the United States and the recommendations of the late Committee on Nitrate Supply.

Potash

Domestic Potash Production (82348). 3000 w. Eng & Min Jl—Nov. 10, 1917. Resources and their development.

The Recovery of Water-Soluble Potash as a By-Product in the Cement Industry (82190 B). William H. Ross and Albert R. Merz. 4500 w. Jl Ind & Eng Chem—Nov., 1917. Experimental study to ascertain the percentage of potash.

Salt

The Brenham Salt Dome, Washington and Austen Counties, Texas (82381 N). Oliver B. Hopkins. Map & well logs. 10 pp. U S Geol Surv. 661-G—Oct., 1917. Location, topography, geology, wells drilled, etc.

The Palestine Salt Dome, Anderson County, Texas (82380 N). Oliver B. Hopkins. Maps. 18 pp. U S Geol Surv, Bul 661-G—Oct., 1917. Location, topography, geology of this and surrounding districts.

Tin

Concentration of Tin Gravels and a Proposed Alternative for Sluice-Boxes and Twommels (82115 A). W. W. Richardson. Ills. 2200 w. Min Mag—Oct., 1917. Details of improved method.

Titanium

The Metallurgy of Titanium (82455 B). Robert J. Anderson. Ills. 14 pp. Fkn Inst, Jl—Nov., 1917. Serial, 1st part. Various uses and methods.

Tungsten Works

Tungsten Manufacturing Works at Widnes (82374 A). Ills. 2200 w. Engng—Oct. 26, 1917. The works and details of the processes.

OIL AND GAS

Benzol

Laboratory Methods for Benzol-Recovery Plant Operation (82224 A). F. W. Speer, Jr. Ills. 6000 w. Met & Chem Eng—Nov. 1, 1917. Serial, 1st part. Details of laboratory methods for by-product coke oven plants, worked out by the Koppers Co.

Fuel

See same heading under Coal and Coke.

Gasoline

Solvent Gasoline (82191 B). C. Olin North. 4000 w. Jl Ind & Eng Chem—Nov., 1917. Experiments made for securing a good grade of solvent gasoline at a reasonable price by cracking heavy oils.

The Supply of Gasolne (82355). Milton A. Allen. 1500 w. West Eng—Nov., 1917. Methods of increasing the supply.

Natural Gas

The Natural Gas Situation in Cleveland During the Winter of 1916-1917 (82164 B). George L. McKibben. 9000 w. Cleve Eng Soc, Jl—Sept., 1917. Report of the natural gas survey and history of production, consumption, waste, etc.

Oil

La Transformation Des Huiles Minérales Lourdes (82657 B). Ills. 4000 w. Génie Civil—Oct. 13, 1917. Review of processes of distillation and cracking of heavy oils.

Oil Fuel

See same heading under MECHANICAL ENGINEERING. *Steam Engineering.*

ORE DRESSING

Copper

Heap-Leaching of Copper-Sulphide Ore (82687). Courtenay De Kalb. Ills. 4500 w. Min & Sci Pr—Nov. 24, 1917. Methods at Copper Queen mine, Bisbee, Arizona.

Electrometallurgy

Electrolytic Treatment of Complex Zinciferous Ores (82421 A). P. M. Gillies. Read before Soc. of Chem. Ind., Victoria. 1800 w. Aust Min Stand—Sept. 27, 1917. Serial, 1st part. Briefly describes the principal methods employed in producing zinc, particularly electrolytic methods.

Flotation

Chemicals Used in Ore Flotation (82194 B). Oliver C. Ralston and L. D. Yundt. 5000 w. Jl Ind & Eng Chem—Nov., 1917. The use and theories of action; the possibilities.

Flotation of Chalcopyrite in Chalcopyrite—Pyrrhotite Ores of Southern Oregon (82223 A). Will H. Coghill. 2200 w. Met & Chem Eng—Nov. 1, 1917. Results of an investigation.

Notes on Vacuum Filtration of Flotation Concentrates (82519). Ralf R. Woolley. 1800 w. Eng & Min Jl—Nov. 17, 1917. Drying of material with low mineral content must be done cheaply.

Milling Plant

The United Eastern Mining and Milling Plant (82506 D). Otto Wartenweiler. Ills. 20 pp. A I M E, Bul—Nov., 1917. Details of a new reduction plant and its operation.

Smelting

The Partridge Smelting Furnace (82392 N). Allen R. Partridge. Ills. 1500 w. Can Min Inst, Bul—Nov., 1917. Its construction and maintenance.

Tailings

Ammonia Leaching of Copper Tailings at Kennecott, Alaska (82344). Horace M. Lawrence. Ills. 4500 w. Eng & Min Jl—Nov. 3, 1917. Development of process; details and cost.

PRECIOUS METALLURGY

Assaying

Bone-Ash Cupels (82503 D). Frederic P. Dewey. 29 pp. A I M E, Bul—Nov., 1917. Gold and silver absorption in assaying are investigated.

Oxidized Gold Ore

Solving the Ore Treatment Problem at White Caps Mine (82602). John G. Kirchen. Ills. 1500 w. Eng & Min Jl—Nov. 24, 1917. Peculiar mineralogical composition of the ore caused fouling of the solution. Trouble mainly in the stibnite present. How the problem was solved.

Silver

L'Argent Et La Guerre (82668 B). L. De Launay 1900 w. La Nature—Nov. 3, 1917. Production of silver, and the war's effects.

MISCELLANY

Briquetting

Briquetting of Non-Ferrous Light Metal Scrap (82446 F). A. L. Stillman. Ills. 3500 w. A I Met, Jl—Sept., 1917. Things of importance in the manufacture; details of the Ronay press and process

Year Book

Year Book of the Bureau of Mines, 1916 (82580 A). Van. H. Manning. Ills. 165 pp. U S Bur Mines—Bul 141. Investigations in mining and metallurgy. More important work of the Bureau during the year.

CONDUCTING TRANSPORTATION

Discipline

Railroad Discipline Without Suspensions (82473). E. H. Heath. 3000 w. Ry Age Gaz—Nov. 16, 1917. Remarks on the Brown system.

Interlocking

New D. L. & W. Interlocking in Buffalo (82252). B. T. Anderson. Ills. 1500 w. Ry Sig Engr—Nov., 1917. Old mechanical plant rebuilt.

Railroad Problems

The American Railroads in War Time (82590). Hale Holden. 1800 w. Ry Age Gaz—Nov. 23, 1917. Address before the Nat Ind. Traffic League, New York City. Review of War Board's problems.

Signalling

Some Impressions of Continental Signalling Practice (82575 A). R. S. Griffiths. Read before Instn. of Ry. Sig. Engrs. Ills. 4500 w. Ry Engr—Nov., 1917. Particularly installations for single lines.

Train Control

New Train Control System on Great Eastern of England (82253). T. S. Lascelles. Ills. 1600 w. Ry Sig Engr—Nov., 1917. System, in experimental operation, designed by E. S. Tiddeman.

MOTIVE POWER AND EQUIPMENT

Air Brakes

The Automatic Straight Air Brake (82250 A). Ills. 1500 w. Ry & Loc Eng—Nov., 1917. Details of a new system of air brake mechanism.

Ambulance Trains

Ambulance Trains for the Continent (82378 A). Ills & Plate. 500 w. Engr—Oct. 26, 1917. Detailed description.

Draft Gear

A Study of Friction Draft Gear Capacity (82475). Louis E. Endsley. Abstract of paper before Can. Ry. Club. Ills. 2500 w. Ry Age Gaz—Nov. 16, 1917. A travel of four inches or more is recommended.

Freight Cars

The Freight Car—A Factor in Winning the War (82394 N). E. H. De Groot, Jr., with discussion. 38 pp. N E Rd Cb—Oct. 9, 1917.

Locomotives

Conversion of Freight to Switch Locomotives (82209). W. H. Hauser. Ills. 800 w. Ry Age Gaz—Nov. 2, 1917. Obsolete engines rebuilt for modern service.

Locomotive Design and Construction from a Maintenance Standpoint (82514). W. H. Winterrowd. Read before Can. Ry. Club. 2500 w. Can Engr—Nov. 15, 1917. Importance of design in relation to maintenance.

Pennsylvania Electric Freight Locomotive (82598). Ills. 2500 w. Ry Age Gaz—Nov. 23, 1917. Notable features of the running gear construciton and the electrical equipment.

Refrigerator Cars

The Ability of Refrigerator Cars to Carry Perishable Products (82395). M. E. Pennington, with discussion. Ills. 30 pp. St L Ry Cb, Pro—Oct. 12, 1917. The saving of foodstuffs, their transportation, and related topics.

PERMANENT WAY AND BUILDINGS

Railroad Shop

Historic Railroad Shop in Nevada (82565). Frank A. Stanley. Ills. 1500 w. Am Mach—Nov. 22, 1917. Shop established at Carson City, in 1870.

Rails

Mill Inspections of Rail in 1915 and 1916 (82167 N). M. H. Wickhorst. 2000 w. Am Ry Eng Assn, Bul—Sept., 1917. Reports results of inspections, and discusses the specifications.

Rail Failure Statistics for 1916 (82168 N). M. H. Wickhorst. 30 pp. Am Ry Eng Assn, Bul—Sept., 1917. Statistics for the United States and Canada for year ending Oct. 31, 1917.

Transverse Fissures in Steel Rails (82498 D). James E. Howard. 12 pp. A I M E. Bul—Nov., 1917. Causes of transverse fissures, or fatigue fractures.

Rail Tests

Influence of Gage Length on Elongation in Drop Test of Rails (82169 N). M. H. Wickhorst. 800 w. Am Ry Eng Assn, Bul—Sept., 1917. Study, with drop test results.

Tests of Manganese Steel Rails (82170 N). M. H. Wickhorst. 20 pp. Am Ry Eng Assn, Bul—Sept., 1917. Reports of tests by a number of railroads.

Terminals

Establishing the Railway Terminal at Camp Dix (82585). W. F. Rench. Ills. 1500 w. Eng News-Rec—Nov. 22, 1917. Design and construction methods different from ordinary practice.

Problem of Freight Terminals for Railroads in Large Cities (82304). Hunter M. Merriwether. 2500 w. Mfrs' Rec—Nov. 8, 1917. A study of terminal enterprises.

Terminal Developments at Vancouver, B. C. (82601). Ills. 2500 w. Ry Age Gaz—Nov. 23, 1917. The Northern Pacific-Great Northern station.

Tracks

Second Track Construction on Southern Railway (82327). Ills. 7000 w. Ry Age Gaz—Nov. 9, 1917. Additional facilities to meet increased traffic improvements in grades and curves.

Turntables

Electrically-Operated Locomotive Turntable (82141 A). Ills. 800 w. Engng—Oct. 12, 1917. Construction and operation.

ROADS AND PROJECTS

Australia

The Australian Transcontinental Railway (82377 A). Map & Ills. 1000 w. Engr—Oct. 26, 1917. Account of this recently completed line between Kalgoorlie and Port Augusta.

Virginian Ry.

The Virginian Railway (82142 A). Map & Ills. 2000 w. Engr—Oct. 12, 1917. Detailed description.

TRAFFIC

Car Interchange

A Study of the Car Interchange Situation (82208). Samuel G. Thomson. 5500 w. Ry Age Gaz—Nov. 2, 1917. Empty mileage and proper maintenance important factors in distribution plan.

Efficiency

Non-Essential Transportation May Be Curtailed (82596). 3500 w. Ry Age Gaz—Nov. 23, 1917. Ways of increasing railroad efficiency.

Freight Loading

Education in Freight Loading by Means of Photographs (82329). Martin P. Kennedy. Ills. 800 w. Ry Age Gaz—Nov. 9, 1917. Notes on damaged freight and the causes.

Rates

Proposed Eastern Freight Rate Increase (82330). 5000 w. Ry Age Gaz—Nov. 9, 1917.. Hearings before the Interstate Commerce Commission.

Railway Regulation and Control (82474). 4000 w. Ry Age Gaz—Nov. 16, 1917. Hearings at San Francisco before the Newlands Joint Committee on Interstate Commerce. Rigid long and short haul clause urged.

Reconsignment

First Prize in Reconsignment Privilege Contest (82326). R. C. Munholland. 4000 w. Ry Age Gaz—Nov. 9, 1917. Present abuse of the privilege and reason therefor: suggestions for a new system.

Traffic League

National Industrial Traffic League (82597). 2500 w. Ry Age Gaz—Nov. 23, 1917. Discussions of demurrage, bills of lading, express rates, etc.

MISCELLANY

Engineer Corps

The Work of the Army Engineer Corps (82600). Ills. 1500 w. Ry Age Gaz—Nov. 23, 1917. Work of the railway section.

Women Workers

The Employment of Women in Railroad Work (82595). Stuart Bready. Ills. 3000 w. Ry Age Gaz—Nov. 23, 1917. Number increasing rapidly. Their duties.

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An Industrial Achievement of the War

Widespread Application of Management Principles in the Ordnance Bureau of the Army

By L. P. Alford

During 1918 the Ordnance Bureau of the United States Army will manufacture and procure ordnance material to the value of over $3,500,000,000. From 75,000 to 100,000 different items will be involved. The vast organization for handling this tremendous amount of industrial business has been created in the brief time since the outbreak of war. It is the greatest and most impressive application of the fundamental principles of industrial organization and management that has ever been known in the United States.

THE recent Congressional investigations of the War Department have shown the nation something of the magnitude of the task of raising our Army, equipping it for service and keeping it supplied with everything needful. The responsibility for procuring the tools with which the soldier fights rests upon the Ordnance Bureau of the Army, which operates all of the government arsenals, orders materials from private manufacturers, oversees the inspection of everything that is procured, stores the articles after they are finished and arranges for their transportation to the point where they are to be used.

When war broke out eleven officers were on duty at Washington in this Ordnance Bureau. Today in Washington alone there are over 1600 officers detailed to the work of this Bureau. During the year 1918 the value of the ordnance material that must be procured for our Army will probably range between $3,500,000,000 and $4,000,000,000. The total number of items involved will range between 75,000 and 100,000. These figures and quantities show that the Ordnance Bureau of the Army is now the greatest industrial organization we have ever known, gaged by the volume of business to be handled. We have nothing in private industry with which it can be even remotely compared.

If the reader will consider that a medium sized business is pleased to add $100,000 a year to its gross overturn, and if a larger business increases $1,000,000 or $10,000,000 in a year the fact is presented by the president of the corporation with a feeling of satisfaction, and if the reader will consider again that there are very few manufacturing firms in the United States that do a business of $100,000,000 a year, by comparison he can begin to realize something of the size of the task of handling a business from 35 to 40 times greater in volume than the last huge figure mentioned.

Ordnance material covers broadly everything with which the soldier fights. It includes his rifle and his bayonet, his bandolier and rifle cartridges, his mess kit and canteen, his revolver and trench knife (if he has them); it includes artillery equipment complete, guns, limbers, caissons and gun sights, battery commander's telescopes and range finders, the shells, fuses and detonators for the guns, the transportation equipment of all kinds for moving the guns to the front, setting them in their emplacements and furnishing the stream of projectiles that they need in such enormous quantities; it also includes harness and saddlery for the artillery horses, and trench warfare material—new items on the American list. This tabulation is fragmentary and almost inconsequential, for before this year closes it is expected the number of items will reach well toward the hundred-thousand mark.

SERVICE OF INDUSTRIAL EXECUTIVES

The manner in which the business machine has been constructed to handle this tremendous task is of interest to every industrial executive, and should be a source of especial gratification to every industrial manager,—for many distinguished industrial managers of the United States have been taken into the Ordnance Bureau as reserve officers and under the direction of Major General William Crozier, Chief of Ordnance, and Brigadier General C. B. Wheeler, now Acting Chief of Ordnance, the principles of industrial management have been firmly established in the planning, administration and control of the Bureau's affairs. The list of reserve officers carries the names of many of the better known consulting industrial managers of the United States. It is stated that 32 per cent. of the active members of the Taylor Society are now in this service.

AMPLE STORES OF ORDNANCE MATERIAL ALREADY UNDER CONTROL

Although this paper purposes to outline briefly the plan of organization of the Ordnance Bureau, it is proper to digress for a moment and present a comprehensive statement of the work accomplished. The task before the Bureau was to supply all the ordnance, or fighting material, needed by the Army. It is obvious that the responsibility for obtaining a continuing flow of this material outweighed the demand to satisfy hasty needs. So the plan that the Bureau wisely followed was a clean-cut policy looking forward to the continuing months of the war.

It can be confidently stated today that within a very few months there will be greater stores of ordnance material in the United States than can possibly be shipped to our Army in France this year, never mind how much we push the shipbuilding. Within a very few weeks there will be such a rifle output that there is no reasonable possibility of there ever being any shortage at any time throughout the operation of the war. These achievements clearly overshadow any situation of temporary shortage which may have existed among the troops in this country during the training period of the last few months. Testimony given before the Congressional investigating committee has assured the country that every soldier who embarked for France has had full and complete personal equipment.

ORGANIZATION OF THE BUREAU

Turning back to the organization and management of the Bureau in the broad general plan, administration and control centers in the office of the Chief of Ordnance, which is in consultation with the organizaitons that are directing military affairs and with advisory civilian agencies. The control from the Chief of Ordnance is through four operating divisions, namely: Procurement, production, inspection, supply. The first three of these deal with the manufacturing arsenals of the government and with private manufacturers who have taken government contracts. The output from all of these arsenals and plants flows to the supply or fourth division which distributes to the military forces of the United States and our expeditionary forces over seas.

The broad duties of the divisions are self-evident from their titles. The procurement division places all of the orders; the production division regulates production, except as regards price and quality; the inspection division handles all questions of quality, certifying to the acceptability of everything produced; and the supply division stores and distributes.

THE SUPPLY DIVISION

At the outbreak of the war the Ordnance Bureau had in operation, to an extent needed for peace-time business, the functions of procurement, production and inspection. Comparatively speaking the matter of supply was unimportant and ordnance material was stored at the manufacturing arsenals. One of the first acts of organization was the establishing of the supply division by the Chief of Ordnance, General Crozier, on May 23, 1917. Colonel (now General) Charles B. Wheeler, was placed in charge. The general duties of this division were stated to be: To take charge of all ordnance and ordnance stores procured by purchase or manufacture for issue to the military service, to arrange for the shipment of this material to the proper points, for its storage and custody, for its preservation from deterioration and for its issue to troops or other persons in military service. The execution of this order involved the creating of an organization and personnel to carry on the work, obtaining precise information as to what would be required by the military forces of the United States, and the relieving of the production divisions of the Bureau of the storage and issue of all supplies.

The beginnings of this work are brought home more forcibly when it is pointed out that the division began to operate on May 24, 1917, with Colonel Wheeler in charge, assisted by Mr. H. K. Hathaway (now Captain Hathaway), a young woman stenographer and a negro messenger. At the present time this division alone has a staff of 400 officers at arsenals, private plants and with troops, a number of civilian experts and advisors and over 850 civilian employees. Among the officers and advisors are many of the best trained management experts of the country. Therein lies much of the secret of the results that have been obtained.

PERSONNEL OF THE BUREAU

No private industrial firm could possibly have obtained such expert services. Most of these men were under engagement in the places where they were working, and only gave up those responsibilities because of the national need. No private offer could have induced them to have changed their employment.

The taking up of this work has involved in practically every case a considerable reduction in salary. It is estimated that in the grades of second and first lieutenants, the salary paid to the men who have taken commissions in the Officers' Reserve will average not more than two-third to three-fourths of what these men were earning in private life; in the case of captains, the salary now received is not over one-half of what these men formerly earned; and in the case of majors the salary now received is anywhere from one-half to one-tenth or even one-twelfth of that which these men were earning in private industry.

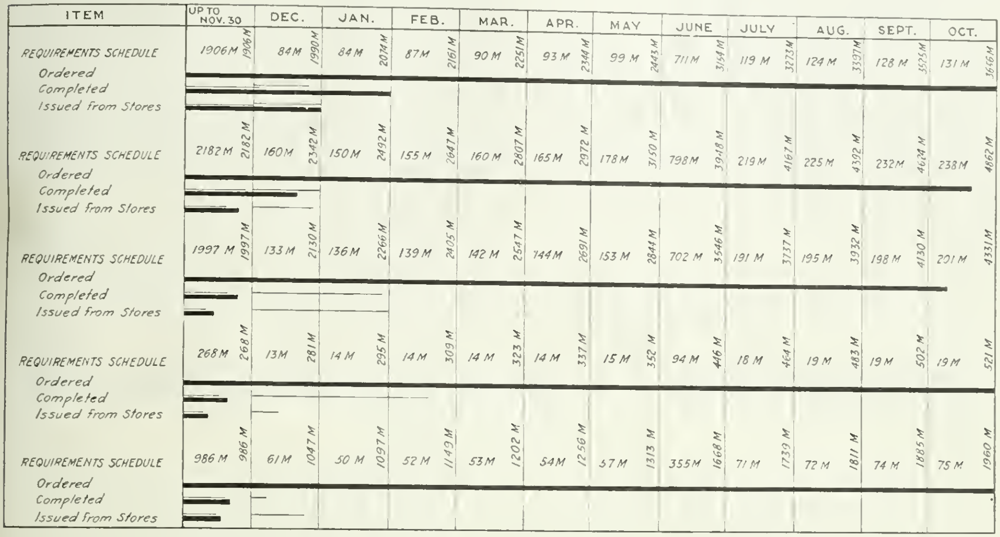
When it is shown that the rolls of the Ordnance Department carry the names of over 1600 of these men, some appreciation is had of the money sacrifice that they have made to help the government and the nation.

The acceptance of these reduced salaries is also a guarantee of the disinterested quality of the work that these men are doing, and is a further guarantee to the nation of the effectiveness with which the work is being planned and executed.

The beginning of the supply division has been outlined and the growth of its personnel indicated. This is the first division to become completely organized. It therefore stands as a model or example for other divisions and government bureaus having to do with the same problems.

THE SUPPLY DIVISION IS COMPLETELY FUNCTIONALIZED

The supply division is completely functionalized and its organization is visualized through charts. The operating mechanism employed are those of the Taylor system. The products, if they can be so called, that pass through this division are procurement orders, reports of materials furnished and requisitions for ordnance material. It is unnecessary to describe in any detail, the handling of these transactions; sufficient to say, they are routed through the division, checked and followed up in keeping with the principles of planning and routing that have been put into effect for handling the product of industrial plants operating under the Taylor system. As a result it is possible to trace and locate any requisition as desired; it is possible to follow-up and expedite any requisition that is delayed; it is possible



GANTT CHART SHOWING RELATION OF MATERIAL ORDERED, COMPLETED AND ISSUED TO SCHEDULED REQUIREMENTS

HORIZONTAL FIGURES show schedule of monthly requirements.

VERTICAL FIGURES are summation of horizontal figures, that is, total scheduled requirements to date.

ORDER—HEAVY LINES show relation of orders placed to requirements schedule. Thus a line ending Oct. 1, shows that orders are placed at posted date for requirements to Oct. 1.

COMPLETED—HEAVY LINES show relation of completed material to requirements schedule. Thus a line ending January 31, means that material scheduled to that date has been completed at posted date of ———

ISSUED FROM STORES—HEAVY LINES show similar relations for material issued from stores.

ACTUAL QUANTITIES at posted date can be estimated from vertical figures near end of heavy line.

———**LIGHT LINES** show deliveries and issues per month. Thus a line full width of month space shows full delivery or issue of quantity called for by horizontal figures per month. If line extends beyond the month space it retains this original scale.

SCALE varies in different months. It is based for any month on the horizontal figures in that month, except as noted for light lines.

to check the work of each unit and know how efficiently the work is being handled. One unit has in operation a board upon which jobs are assigned either to individuals or to work spaces—desks—in a manner identical to that in use in many manufacturing plants.

At first thought it may seem like a great refinement to handle requisitions—papers—in the same manner that expensive lots of work are controlled in the shop. But when it is realized that the volume of transactions has now reached a total of over 8000 a week and is steadily and rapidly growing, and that nearly 350,000 pieces are turned out weekly by the stenographic and multigraphing forces, the need of mechanism whereby everything can be controlled and followed up is seen to be essential. As regards the matter of accuracy it is worth while to point out that every entry slip when it is written for an item on a requisition is checked after having been transcribed, and that every entry in the balance of stores records is likewise checked after it has been made.

A further extension of the mechanism of the Taylor system is now under way. One feature is the symbolization of every item of ordnance stores. The need of this has arisen for purposes of indexing, to enable the installation of tabulating machines, from the lack of standardization of names for the various articles, and because many of the articles cannot be visualized by name as they are unfamiliar to the persons who come in contact with them, at least for the first few times. For instance, who knows—unless he is experienced—whether a "cavesson" has something to do with the handling of explosives, or the carrying of a soldier's food, or is a piece of harness; and who knows whether a "bouchon" is an article of weoring apparel or some kind of device to be used in killing the enemy?

The Gantt Charts

Mention has been made of the visualization of the records of the Bureau. On April 19, 1917, Mr. H. L. Gantt made a report to General Crozier, at his request, on the organization and management of the Ordnance Bureau and its manufacturing arsenals. One step that followed the rendering of this report was the adoption of Mr. Gantt's chart to present graphically the facts in regard to the needs and progress of orders for all kinds of materials.

This form of progress chart, though a horizontal, straight-line plotting such as Mr. Gantt has previously used in his management work, is in reality a discovery or an invention. A specimen, which illustrates the principle involved, is shown in the chart. This is reproduced from an actual chart, but for obvious reasons the kind of material to which it applies is not indicated. A number of items are plotted. The long line in each case carried forward to October indicates the accumulated needs as expressed in orders. The vertical figure at the end of each month gives the total requirements up to that date. The amount written horizontally in each monthly space is the amount to be supplied during that month. As plotted, the monthly divisions are equal in length. The amount indicated by this length, however, varies according to the monthly needs. So the plotting is to a uniform scale as regards the element of time, and to a variable scale, month by month, as regards amount. Once the principle upon which the chart is constructed is comprehended, it is read at a glance and shows exactly the condition of the requirements and deliveries on the item under consideration. A glance at the first item plotted shows that the total requirements up to the end of October for the first item is 3,656,000, and the monthly requirements from November through October vary from 84,000 in December and January to 711,000 in June.

It is interesting to compare deliveries with needs. It will be noted that on the first item deliveries are a month ahead of needs. Following down through the other items it is seen that in every case the amount completed is ahead of the requisitions and leaves a balance in store.

This form of Mr. Gantt's chart has been adopted throughout the Ordnance Bureau for the plotting of requirements, progress of orders and deliveries. It supplies in compact graphical form the information needed to exercise control. Similar charts are being kept in manufacturing plants executing government contracts so that the local management will possess information in regard to their own performance, and thus be able to have at hand data to exercise control of their own manufacturing.

To summarize briefly, the supply division of the Ordnance Bureau of the Army as now organized and operating is functionalized according to the Taylor principles, has in use many of the Taylor mechanisms, and has its information in regard to requirements and progress in graphical form on the Gantt charts.

It is perhaps not unwise to express the hope that the same plan of organization, or its equivalent, will extend throughout all of the government bureaus and organizations which have to do with the procurement, production, inspection and supply of war materials.

Mastering Power Production--II

By Walter N. Polakov

To lay the foundation for his discussion of the principles and methods of controlling or mastering all of the elements of operation of the power plant, Mr. Polakov *devotes this installment to power plant equipment. He does not deal with specific or concrete examples, but considers those factors which affect the functional condition of the plant and permanently influence the methods and results of operation.*

Mr. Walter N. Polakov *is a consulting engineer specializing in the management of power plants. He was educated in Russia and Germany and held a position of shop superintendent and chief engineer in Russia and was also instructor and consulting engineer to the Naval Academy at Baku. After coming to this country, and prior to taking up his own practice, he was consulting engineer to the Board of Estimate and Apportionment of New York City, consulting engineer for the Penn Central Light & Power Company and Superintendent of Power of the New York, New Haven and Hartford Railroad.*

THERE is, perhaps, no other industrial problem so universal and important as this one of power production. The entire life of an industrial nation hinges upon the source of power that keeps the endless variety of productive and transportation machinery in motion. The whole progress of the last century, both in mode of production and of living standards, was made possible only after the man-power was replaced by the harnessed energy of the universe; the ox-plow was replaced by the tractor, the mule team and coach by steam and electric trains, automobiles and aeroplanes, artisan's tools by automatic factory equipment. Small as it may be the factory power plant or public utility central station is the life center of the community. Stop the supply of power and men and machines are thrown out of their productive work.

Responsibility for Authority

The structure of modern industrial life brings to the attention of engineers and managers this weighty problem of power production. It is truly astonishing how little attention has been paid to the matter of managing and operating power plants; all that has been done, said or written is confined to a limited field of improved equipment. Once the plant was equipped, it was assumed as a matter of course that the result would be commensurate with the salesmen's promises. That the *authority to issue orders involves the responsibility for the results* was too often forgotten, to take pains to study things over which one already had a measure of authority was frequently considered superfluous. Besides we are in the habit of doing the things first and watching the consequences afterward.

Progress in Equipment

Steady decrease of the cost of electricity for the customers was recently heralded by the Edison interests and the *onus probandi* rests with their publicity departments; we must admit, however, that the reduction in the cost of electricity was made possible by inventors, designers and builders of equipment, in spite of the muddling with the methods of its use. Three factors deserve mention in this connection:

Direct current with its limited sphere of distribution was displaced by high voltage alternating current. This made possible the generation of power in large central stations with corresponding commercial advantages of mass-production and comparatively insignificant transmission losses. As a direct consequence, large central stations stimulated the design and construction of large size turbo-alternators of high thermal efficiency, made profitable the installation of large boiler units, double-end furnaces and similar developments. Still further advantages were secured from the wide range of characteristics of the connected load with its diversity factor, off-peak load, etc. This made it possible to serve an accumulative connected load far in excess of the plant's own capacity. Lastly, mass-production of steam with correspondingly great amount of coal and ashes to be handled promoted the development and adoption of automatic stokers, coal and ash handling machinery and use of measuring and controlling instruments. This automatic, centralized mass-production besides possessing evident advantages in marketing the product permitted, even made it imperative, to employ highly specialized operators in place of cheap but inefficient laborers.

Effect of Costly Equipment

While this evolution materially reduced the operating expenses owing to the high thermal efficiency of equipment, managerial methods as a rule remained the same as those in vogue in the small isolated plants. Moreover, the fixed charges increased both per plant and per unit of capacity. This growing financial burden has created a new problem. How to absorb the expense of wear and tear, obligations to money-lenders, rent, taxes, insurance, etc.?

Let us take the case of a mechanical stoker installation in a hand fired boiler plant consisting of two 400-h.p. boilers. The cost of the installation was $5800, an-

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SUPPLEMENT TO INDUSTRIAL MANAGEMENT

February, 1918

ERRATA

As owing to an unfortunate oversight, Mr. Polakov was not given an opportunity to read the page proofs of his article before this issue went to press, the following errata, with corrections, are shown herewith:

Page	*Column*	*Line*	*Printed*	*Should be*
101	1	23	"gross"	"net saving we"
102	1	8	"*productive*"	"is a *protective* expense"
102	2	3	"plue"	"blue"
102	2	6	"power"	"mill plant"
102	2	bottom	"$795.70"	"$705.70"
104	2	20	"plant to the"	omit word "to"
104	2	51	"power"	"arrangement of machinery is"

—The Editors.

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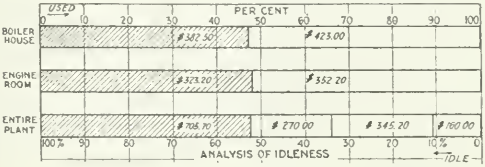
creased investment means, of course, increased interest, rent, maintenance expense, insurance charges, etc. Since a more efficient machine does not live longer than a crude and cheaper one, the annual depreciation charge rises still more rapidly. While the rate of profit falls, the mass of profit or the total profit could, however, be maintained or even increased in two commonly used ways:

1. By increasing the selling price.
2. By increasing the output.

In this we assume that the mode of using the equipment is at all time such as to secure the full advantage of its ultimate efficiency.

Of the two ways, the increase of selling price is not always possible and seldom desirable, as it may ultimately reduce the volume of business. Opposed to this, price reduction on such a commodity as electricity ordinarily stimulates its use and increases the volume of the business to a proportion that is sufficient to more than offset the increased obligations.



pendent of output. To this group, in our sense, also belong such expenses as cleaning, sanitation, watchman, repair shop, stable, etc.

The total of all these constant expenses must be prorated either per each production unit such as boilers, generators, etc., or per productive group or plant-section such as boiler house, tubine room, high tension room, etc.; but since in the manufacture of power lack of load reflects proportionately on all of them unless the equipment capacity is poorly proportioned in various stages, the constant expenses can be prorated more conveniently per unit of output (1,000 pounds of steam, k.w.h., etc.).

If the plant is operated only at half its capacity, it is quite evident that a smaller one would do and all rental expenses on the idle portion of buildings, equipment, etc., cause a loss which is evidently due not to operating methods. It is but a business charge incurred because of lack of business or because of expectation of future usefulness or errors in estimated needs, or anything else.

In many plants a special problem arises from the necessity of keeping a number of boilers banked for a considerable time. Coal used under these banked boilers is not productive but is a *productive expense* and must be shown on a separate account the same as other insurance expenses, and must receive due consideration in the final analysis of the cost of idleness.

Certain simple records must be kept in a plant to enable accurate analysis of idle expenses and proper allocation of their causes. Generally an intelligently composed power plant log furnished the necessary basis for disbursement of the non-productive portion of power expenses. If the expenses are prorated on hourly output or plant section basis, the number of hours each unit was in operation, ready for operation or idle should be recorded, preferably graphically. Ordinarily only the following records are needed:

1. Net output (k. w. h. or M lbs. steam).
2. Hours and numbers of boilers banked and generators phased (stand-by service).
3. Hours and number of water wheels idle (due to lack of water power or lack of load).

The cost of idleness from the above data is summarized on a chart which combines graphical visualization with actual figures and analyzes the cause of idleness into classes. By division of a plant into three general groups: generating steam, generating electricity and transforming and feeding energy into lines, increased usefulness is gained. Besides measuring a loss and allocating its cause at a glance, it shows clearly whether any group of equipment is disproportionately large or which process (if any) acts as a damper on more complete utilization of the equipment.

Such a chart may be plue-printed and distributed among all the officials whose coöperation is necessary.

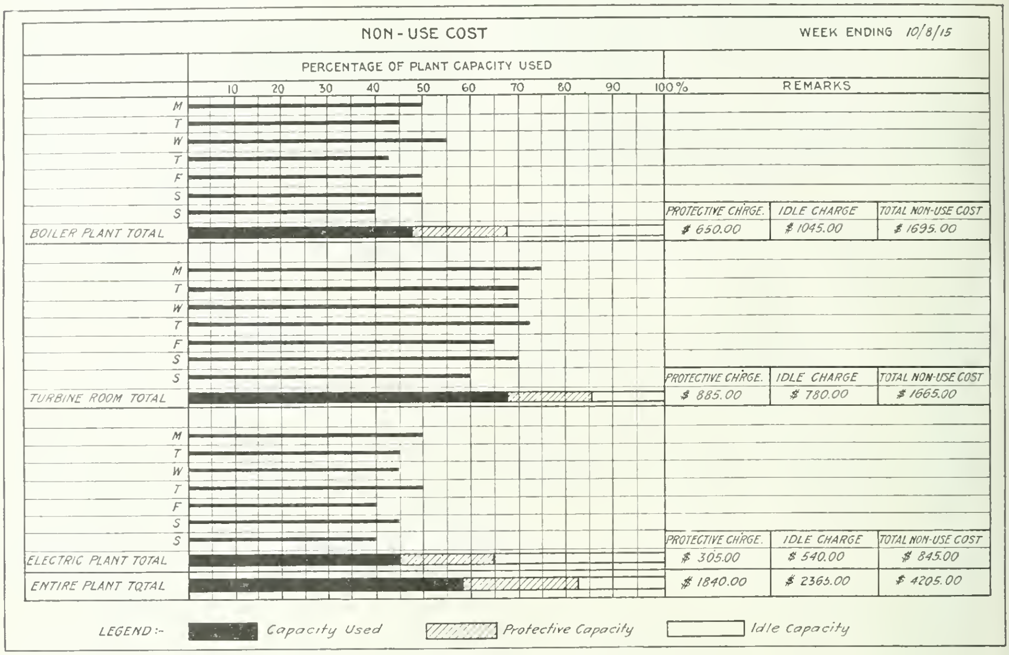


CHART 2. PLANT OPERATING ON ELECTRIC RAILWAY
Note excess of boiler capacity causing large portion of boiler room to stay idle

EXAMPLES OF IDLENESS

To illustrate our point let us consider a mill power:

Interest on investment	$4000
Interest on yard and rent	500
Taxes	1950
Insurance, fire	75
Insurance, boiler	550
Insurance, liability	125
Insurance, fly wheel	70
Depreciation	9500
Water rights	1000
Total per year	$17,770

Since this plant generates both steam for processes and electric power these charges are as follows:

	Annual	Hourly
On boiler house	$ 9665	$1.35
On engine room	8105	1.12
	$17,770	$2.47

Inasmuch as the safe output of the boilers with due reserve is 54,000 lbs/hr. the overhead charge per M lbs. is 2.5c, whereas the charge per k.w.h. is 0.112 + 0.09 = 0.202c. During the month the steam output was 15,300 M lbs. and electrical output 160,000 k.w.h. Therefore:

	Absorbed	Idle	Total
On steam plant 15,300 × 2.5c =	$382.50	$423.00	$805.50
On electric plant, 160,000 × .202c =	323.20	352.00	675.40
Totals	$795.70	$775.20	$1480.90

In other words, more than half of the capacity of the plant was idle during this month. This in itself was analyzed by causes as follows:

Avoidable	Mill shut down 4.5 days	$270.00
	Lack of load when running	345.20
Unavoidable	Reserve capacity	160.00
Total		$775.20

makes the generation of power a wasteful operation but frequently spoils the goods manufactured or hampers the manufacturing processes in some very important detail.

(e) Not infrequently instances are found where repairs or replacement cannot be made for the lack of room around the machinery which was occupied or built up after the machine was installed.

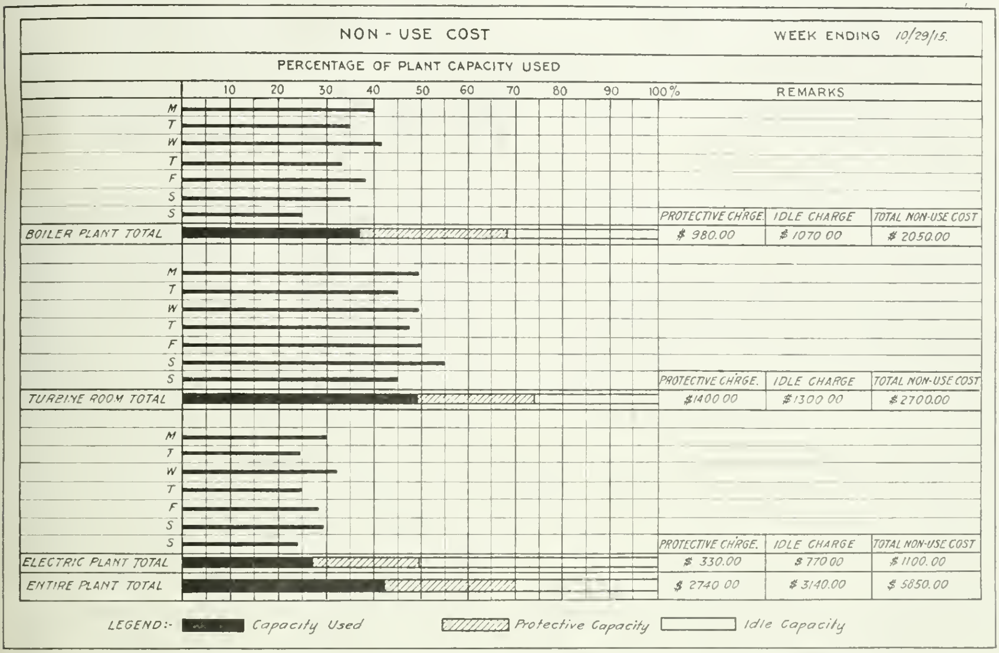


CHART 3. SAME PLANT AS ON CHART 2 WHEN PURCHASED POWER IS FED INTO LINES

Note increased total non-use cost and large idleness of electric equipment. Twice as many boilers are now banked to protect the supply company against peak load and to safe-guard service from interruption

The location of a power plant in or among the factory buildings has a great deal to do with the economy of operation and besides, quite materially affects the cost of power at its ultimate place of consumption. As is often the case in an old and growing concern as the demand for power, light, heat and ventilation grow with the development of the business, the necessary additions were made, not in accordance with a well defined original plan, but when and as the expediency demanded. The consequences are many and sometimes so serious that scrapping of the entire old equipment and the erection of a new plant is more economical than the continuation of waste of energy and material in the old plants.

(a) Scattering the equipment in an uncentralized plant requires more operating labor, makes repairs difficult, handling of coal, ashes and materials expensive, supervision inconvenient, accidents more likely, rent higher, often interfere with manufacturing, etc.

(b) The piping in such a case is necessarily too long with corresponding losses, is frequently unfamiliar to newer employees with the result of leaking valves, inoperative traps, excessive number of bends, reducers, etc.

(c) Absence of isometric or perspective diagrams causes much confusion in inspection, neglect in operation, danger in emergency, etc.

(d) Equipment capacity poorly proportioned for the service, or equipment not adapted for the work not only

In the endless variety of such cases re-location or remodelling of generating equipment, forms of transmission of power, etc., is frequently inadvisable for some reason or other, such as lack of space, lack of capital, loss of production during reconstruction and the like, but whenever such a remodelling is possible and advisable from the economic standpoint no architect or contractor should be called on the job until the manufacturing executives have presented their requirements to a power specialist.

Physical Characteristic of Power Plants

The physical characteristic of a power plant is determined by three main factors:

1. Location of the plant and its fitness for the service.
2. Arrangement of units in relation to one another in space.
3. Inherent efficiency of the equipment.

A power plant may be defined as a mechanical installation, which is capable, under human will, of transforming a certain form of incarnate energy (either potential or dynamic) *into some other desired form of energy within predetermined time and space.*

Location

Of all the physical conditions permanently affecting the economy, the location of a plant is all important and practically unalterable. The most influential of these local conditions are those in relation to:

A. fuel, B. water (for boilers and condensers), C. labor, D. transportation, E. neighborhood, F. population, G. legislature.

A. Inasmuch as fuel is the most important factor both in expense and in efficiency of any steam or other thermal power plant it is evident that, 1. sufficient supply of fuel; 2. minimum haulage or transportation, are the conditions of greatest importance. While it is impracticable to locate always at the mouth of the coal mine or in the middle of the oil field, those plants that pay less for fuel transportation have economic advantage in addition to being more desirable from the national viewpoint of conservation of efforts.

B. Water supply closely follows fuel in affecting the operating cost and safety of the plant. Water supply bears upon:

1. water power available, 2. abundance at all seasons for boiler feed, 3. scale forming qualities, 4. sufficiency and temparature for condensation, 5. drinking qualities.

It is altogether desirable to provide every thermal power plant with even a small source of water power. The advantages of such combinations are large and important considering the expenses for banking extra boilers, carrying peak loads, maintaining service during accidents and disturbances, etc., provided the overhead expenses of such installation do not offset the advantages of the cheap source of power. An ample supply of water for boiler feed is of course imperative, and plants depending merely on the city water supply are usually half of the time in a precarious condition (especially in small communities) not mentioning the usual high rate of such water service.

C. While the two above physical conditions of the locality in which the plant is situated materially affect both the character of the equipment, the operating cost and the fixed charges, the labor market and local living conditions in the locality have perhaps still more influence on the managerial problems.

The managerial problems under such conditions become more exacting—all operations are clearly and definitely standardized, written in plain language, instructions are prepared and personal instruction provided in a systematic way. It is not so much the problem of hiring fit men as to make men hired fit the job, and the magnitude of such a task can be appreciated only by those who have actually had the opportunity to solve it.

D. Transportation facilities, both passenger and freight are closely linked with the just discussed local factors. While satisfactory means of receiving adequate and uninterrupted supply of fuel and other materials are readily recognized, especially where considerable fuel storage is not practicable or even impossible. More than one route for deliveries always puts the plant into more secure position, particularly if one is liable to be crippled during certain seasons of the year.

E. In the last analyses, the local conditions, habits, transportation facilities and social environment determine the working hours, length of shifts, rotation of watches, etc. While in general most economical operation can be maintained with four 6-hour shifts in 24 hours, the interplay of various local conditions makes it extremely difficult to put these into practise. Similarly local conditions at times may influence the mode of compensation, being either favorable or hostile to bonus payment.

F. A more or less thickly populated neighborhood exercises great influence on the character of equipment and mode of operation of a central station. It has a still more pronounced effect on the method and equipment used in the transmission of current. Closely related to this is the direction and the rate of the growth of the community served. High-tension transmission, net of substations, underground or overhead lines and allied matters do not directly relate to our subject, yet indirectly, through phenomena like power factor, extent and time of peak loads, diversity factor, greater or lesser importance of voltage regulation, etc., are the local factors of utmost importance for the successful mastering of power production.

G. Legislative regulations as a rule are very unlike in different, sometimes neighboring, states and frequently offer serious problems in management. While one plant cannot employ any but state licensed firemen, the one within the stone's throw is safely operated by men without a tag but with a real knowledge.

PLANT LAY-OUT

While generally speaking the machinery may be moved, in a power plant to the re-location of unfortunately placed equipment is practically prohibitive due to excessive cost of rearrangement of special foundations, flumes, piping and other permanent parts of buildings. In this sense the layout of the plant equipment is a highly important factor permanently affecting the economy of operation. The elements of this order may be grouped as follows: A. unloading and storage of fuel, B. handling of fuel and refuse, C. visibility of equipment, D. accessibility of all parts, E. space for repair work, F. grouping of units, G. centralization of operation, H. safety, K. comfort and hygiene.

A. The cost of unloading and handling coal varies widely, depending on the facilities available; whereas in one plant coal is unloaded from the barge directly into overhead bin in the boiler room, in another plant coal may be shoveled out from cars, carted to a pile then carted when needed to a shed near the boiler room and wheeled in as used.

B. Handling of fuel and furnace refuse influences the cost of operation in a still greater measure. Equipment for weighing and feeding coal to furnaces as well as that for disposing of soot, ash and clinkers in some instances is so costly as not to offer any advantage over manual handling, in other cases no expense should be spared to avoid interruption.

C. The visibility of equipment does not mean merely good illumination. With the limited number of attendants, which is common in modern plants the arrangement of units and especially auxiliaries is often such that the plain view is obstructed by other machinery pillars, walls, etc., thereby jeopardizing safety.

D. The arrangement of power is frequently made without due regard to its accessibility.

E. Closely connected with these handicaps of poor layout is that of lack of working space around the machinery undergoing repair or overhauling.

F. Grouping of units is another fundamental requirement for the successful operation of the plant which seldom receives due consideration from the builders.

G. The principle which we call centralization of operation is comparatively new. Its early demonstration can be found in switch boards with remote control of turbines, etc. In small plants this is carried sometimes to an absurdity by placing panels on a balcony, thus doubling the crew.

H. The importance of safety arrangement and devices are so well recognized that it is hardly worth while to enlarge here on this subject.

K. Lay out of the plant with due regard to the hygiene and comfort of the employee is the paramount requirement from every standpoint.

(To be continued)

Under New Management—A Man's Power

Experts in Industrial Efficiency Have in their Hands a Great Force—the Power of Men

By Charles M. Horton

Through pointing out the dominant possibilities of achievement in every man, the author makes a strong plea for a study of the humanities along with the sciences. For mankind is infinitely more important than inanimate things and stern technology. Efficiency experts must recognize a man's power and direct him through their own work toward the betterment of all.

Mr. Charles M. Horton, *member of The American Society of Mechanical Engineers, was educated in public schools of New York City and at the University of New Mexico. He served a drafting room apprenticeship and had twelve years' experience in designing special machinery. As an avocation he has pursued literary work, writing for both fiction and technical publications.*

THERE is infinite power in a unit of humanity. You may be engaged in the commonest of toil, as your way of earning a living, and yet be possessed of this mightiest of forces. If you are so engaged and are of that vast army of seekers who would do different—would *be* different—the fault lies not outside yourself. It lies within you—with you—and with nobody, or nothing else. Be you such a man, you are but sleeping. All-powerful, did you but know it, you need waking. You have it within you, as all men have it within them, to rise to the heights. You can be anything you want to be, provided you want it hard enough.

The Fates recognize this for what it is, and will give way before it as surely as all Nature retires before the supreme.

Thomas A. Edison and men of similar deeds differ from average men in this—they are fully awake to the realization of the power in themselves and the latent power in every other man. Each of these masters of things has a still stronger understanding and grasp of the workings of the human mind, and through skillful guidance of the capabilities and possibilities of those around him, he has worked out major ideas and achieved supreme results.

FROM BABY TO ENGINEER

Some thirty odd years ago, in a tenement in a metropolitan city, there was uttered the first faint outcry of a baby; a man-child. A son had been born. The father was struggling with a poor-paying business, principally owing to the fact that he was in an environment unfamiliar to him. He had come from the country. The family was in straightened circumstances—so much so, indeed, as to make it necessary for the son, at the age of fifteen, to quit grammar school and go hunt a job. Advantages—the boy had none, save that he was poor, a sure-enough advantage, indeed. Yet he did have ambition—pride, if you will—and with it that most valuable of adjuncts, an inquiring and restless mind. Among other things, he was a rabid reader. Once he saw in a newspaper a statement by Lombroso to the effect that a large percentage of criminals in French and Italian jails had outstanding ears. The lad cried himself to sleep that night, because he himself had outstanding ears. Later he saw a death mask of Lincoln—and felt better. For the man Lincoln had large ears that stood away from his head.

A seemingly inconsequential thing, yet it was a big thing in that lad's life. It proved one of the turning points in his career. The incident set him to thinking. From that time forward he took nothing for granted. He had learned to reason. He learned to use his eyes—would shoot what he saw back into his reasoning faculties—cut from cause to effect and from effect to cause like a skilled surgeon. He was making progress. He decided, among other things—and this, early—that there was no single road to success for all men. Men varied, he saw, and therefore roads to success, he argued, must vary. A man must determine his own capabilities, and then determine the best and shortest route to success for a man possessed of these capabilities.

So pondered this youngster, with the result that, at the age of seventeen, and after trying out numerous jobs, he found himself and set out. He had decided upon engineering as a career. Also, he had decided that it was up to him and to nobody else. He had found the way—his way—upward. It lay within himself. By what he himself did, or did not would he fail or succeed.

THE ENGINEER'S SUCCESS

He succeeded. To-day he is a recognized engineer of no mean capacity. He paid the price, to be sure. It was more of a price than most men pay because he went far in a short time. And often the end looked distant—at times, unattainable. But he stuck to his last. He believed in the power that lay within himself. Frequently he met with temptations in the shape of attractive offers outside the path he had chosen to take. But he turned them all down. What they had for him was not what he wanted, and he clung grimly to what he wanted. He would be what he wanted to be—what he had set out to be—or he would be nothing. In the end, as I say, he got it. But it cost him much—just as it costs every successful man much to attain his goal. Yet today he is glad of it—proud of his success. He feels that he has not lived in vain. And that is a wonderful—a beautiful, an all-satisfying feeling to know that you have elected a course, and have stuck to it—have made your life a service—your ideals real! No man can do more.

There are many such men. They may be found all around you. Not knowing them intimately, you, of course, cannot know these things about them. They themselves do not talk, or if they do talk, they indulge in platitudes which, for the most part, you feel do not tell the story. Some times they themselves don't know. But of this you may be sure. They traversed no rainbow route to the heights. There is no such road. Success of any kind is a fight from the first faint gasp—an open fight, too—one possible to all men. The secret of it lies in a power within yourself. You are a single unit of humanity. You are one man-power. There is no greater power.

Capabilities of One Man

The difference between the average man and men like Edison and Wright and Marconi and Holland and a dozen other similar men, is that they realized all this and the average man did not. Edison and his kind woke up. Some woke up early, some late; but that matters little. The thing is that they woke up. And by waking up, I mean coming to a full knowledge and recognition, not so much as to their own capabilities, as of the capabilities and possibilities lying dormant in every single unit of man. Each of these men had help from other men in bringing to a successful culmination any one of their major ideas. Each realized the possibilities lying in his next neighbor, and each gently guided those possibilities to his own big end. It was not ruthless dominance; it was just what I called it—a gentle guidance. The result was success, both for the man and the idea. Each had a grip on the workings of the mind—his own as well as those around him—and each won out. The thing is not impossible to any unit of mankind.

I am dwelling on this thing for a purpose. I want to pull engineers, industrial owners, managers, back to a realization of certain things which they now for the most part ignore. I have bitten off a big chunk, and know it. I knew it when I started the first article under the title "Under New Management." But I think the thing worth the candle. Too great impetus given to science in the last twenty-five years has carried its followers past and beyond things of no less moment to humankind than science itself. Science is beautiful when rightly understood, rightly used, rightly pursued. But so is humankind. And, in the last analysis, humankind is infinitely more important. I well realize that the first automatic machine thrust civilization a great step forward. And I am not unaware of the fact that science developed the first automatic machine. But I know something else. I know that the onward rush of these things, the wild, pellmell haste to keep up on the part of men of science, has reduced these men to a very low "sensitometer" regarding their relations and duties toward—even their working knowledge of—their fellowmen. But not all men of science, however, for I firmly believe Henry Ford, for instance, to be sincere in his humanitarian endeavors. Nevertheless I have heard it said that men who work in the Ford plants are either slaves or slave drivers.

The Study of Mankind

All of which suggests something. It suggests the new note which is creeping into our current literature. This thing is human study. More and more, editors are printing matter on this subject. Editors are taking the pulsebeat of the times. They are alive to the new era. The world of affairs is turning over. Thinkers for long have known this—but the world of industry, blind with its own carbon, surged forward without regard. One of the results of the world war is the slogan, serve the State—serve industry, in other words—the individual does not count! It is the slogan of Force. That the individual does count is evidenced by what the individual is doing on both lines paralleling No Man's Land. Always the individual has counted—witness the Magna Charta—and always the individual will count. For the power of a single unit of humanity must be reckoned in the calculations. It is being so reckoned today—after the seeming breaking down of civilization. Men are asking themselves questions. We are thinking less of matters and the vagaries of romantic writers and rather more of man the man—mankind, humanity—the power wrapped up in a single organism of life.

The Human Unit

A man in overalls is a single unit of humanity. He is a man-power—no more, but certainly no less. As a productive agent he may be more or less than the great average, depending on his own capabilities and initial training, depending also upon whether he did or did not wake up. But he is an agent, a unit of force, a man. He may be in overalls through personal misfortunes, or he may—and generally is—in overalls through choice. I wish I might drive home this last. Executives are inclined to overlook it. They are inclined to look down upon the man in overalls, secretly, of course—to underrate him as a being. There never was a greater wrong done. Show me a gang of workmen, and I'll show you a greater percentage of men of ideals—and sticking to them—than will be found among a like sized group of executives. I know whereof I speak because I have associated intimately with both extremes in the industrial world, and was looking for these things.

But to return.

In an assemblage of men in overalls always I see embodied the true humanity. Men of force, of dominance—equally with nations of force and dominance—do not reflect those first teachings of that lowly group on the edges of the Red Sea two thousand years ago. I say this, lest we forget—lest we forget, you and I. President Wilson realized this, and held the forces of this nation in check until the very principles for which he held the nation in check were so violated as to compel him to unleash a counter force of equal might to stay the first ruthless force. In my estimation, President Wilson is a true humanitarian—the third greatest President we have had—because he is the third great humanitarian who has occupied the executive chair. Lincoln was the second, and Washington was the first. Each one was a single unit of humanity, each represented a single unit of man-power, and each—get this—was a man who viewed science with unfamiliar eyes. Being what they were, each one because he was what he was—a true humanitarian—wielded a power greater than ever science wielded at its grimmest best. Science and the Humanities! "There ain't no such animal"—not *in toto*—because today the two things are rank opposites. But there can be, and there will be a union of them by and by.

Efficiency and Humanity

The true efficiency man is a humanitarian. Understand me. I said the *true* efficiency man. And why? I'll tell you that. His first apprehension upon entering a client's plant for the initial survey—and always he enters with apprehension—has to do wholly with the character of the workmen employed therein. He knows that his success or failure will depend, not on the quality or quantity of the machine tools to be found here, nor yet on the character of the organization as he has been given to know it by one or another of the executives, but rather on the kind of labor, men or women, old or young, which he sees around him. He is dealing more or less with intangibles, and he knows it, or does not, accordingly as he knows his business or does not know it. He has to do solely with the human element; and because the human element is so little known and understood by employers, he himself—like his profession—like the results of his endeavors in practicing his profession—is uncertain. Sometimes he fails. But that is his fault. He fails because he is lacking in knowledge of the fundamentals of humanity.

I think I hear someone asking where to go, what to study, to gain a knowledge of the humanities. I can only say with some wise one of the past, "the proper study of mankind is man." It is no exact science, as yet, but rather is it founded on age-old observations handed down to us from barbarous, even savage, ancestors. Therefore, efficiency men are born, not made. The true efficiency man is one who is large in the humanities through instinct. He is one who is big in the natural sympathies. There are many such men. The trouble is that the work of efficiency, as such, does not attract men of such larger sympathies, because the work, as practiced more or less today, has as its very root and branch for success the curbing of human instincts.

One such man whom I know quit the game because he could not bring himself to putting a stop watch upon girls. But these mechanisms will not last. True efficiency is aborning, is having its pains and tribulations, its misunderstandings, just as everything new has come into the world. And when it grows to its correct estate, then will appear men of proper calibre to carry it forward and onward to its own. These men, as has been said, will be of native and natural sympathies, men of the type of James Whitcomb Riley, for instance, or Mark Twain—to name men in the popular mind—men whose works show keen interest in and understanding of the workings of the ordinary human intelligence.

Industry Rests on the Human Being

That is it, summed up. Industry will survive or perish on its knowledge of the human being, the single unit of humanity—one man-power. Science must come down off its high-horse; mix with folks; look around, with hands in side pockets, beamingly. It must cultivate a kindly eye, a friendly smile, a genuine and intimate sense of brotherhood. The "holier than thou" attitude no longer will do. Science is not ALL—granting it is much. Science must become one with humanity, not be opposed to it; for in thus becoming one with folks science will learn about folks. There is much to learn—much which science today does not or will not concede. Thinking only of machines, or the scientific equivalent of machines, science views mankind in the light of a machine.

A machine, man operated, turns out so many parts. Ten machines, likewise man operated, will not turn out ten times as many parts. They ought to, but they won't. Up to recently, it was so figured. Efficiency men revealed the truth of the falsity of the science-supplied declaration. Science got a setback.

"Dear, me suz! What has happened—Oh, dear!" This happened: The figures were warped. Something was left out of the calculation—something of most vital importance. Science clean forgot Jim and Tom and Hank. So did the Hohenzollerns—master scientists—in their war calculations. They clean forgot the poilu and Tommy Atkins and the Yanks—the individual, the single unit of humanity—even as the result will prove that they quite overlooked the same thing in their own domains—the men making up their own armies. It will be a fateful oversight.

Industry's Breadth Must Be the Breadth of Education

President Schurman of Cornell University is quoted as saying that "an educated man should know something of everything and everything of something." Admirable goal though this is, it nevertheless is impossible for man to attain. This is an age of specialists. Knowledge has become too wide, too scattered, for a single intellect ever to compass. But we all can attain to a little knowledge of many things. Scientists do not believe this—at least, give no evidence of holding to this belief. And because, like a snowball sent rolling down hill, gathering more snow and yet more snow as it goes, mankind has flocked and continues to flock to the standards of education advocated by scientists, the world has become gradually warped, biased, narrow and bigoted, concerning those things that are no part of science.

Yet these things exist. They always have existed. And always they have had their big share in the advancement of civilization. For what is civilization but a knowledge of the value of truth and beauty in nature, literature and art as these reflect nature! So the classics make for civilization where the sciences make only for the immediate present—the now—ways to an end, a job and a vocation for youth fresh from college. He gets the other thing later, if at all,, through a course in home reading. Granted that the necessity of keeping pace with the times today is a matter of technical knowledge. One *must* grant that as things are in this day and age. Yet how infinitely more desirable it is, if one have a full and happy life, to possess deeply rooted in oneself a knowledge and love of all that which is the very foundation of society—the great masterpieces of literature and art, the profound truths as taught by the lowly Galilean. We passed through this once as a race—the Dark Ages—and then emerged from it. We are out of it today—but rapidly going back. To know a little something about everything will serve to stay us in our civilization.

Specialists In the Humanities

One man-power! That is it. To realize fully the great force wrapped up in a single unit of humanity, and to make use of it—*that* is it! Efficiency men will lead. They will lead because they, above all other professional men, practice in and for and through and on the human elements. They will be the happy go-betweens. Possessed of an insight into the vagaries of the human mind by reason of birth and training, efficiency men—the true efficiency men—will show executives the way—show them wherein the plant may be made productive without robbing Peter—or in this case, Tom and Jim and Hank, or Estelle or Alice or Gladys. The stop watch won't count so much as the rest-room, or the mid-morning period of recreation, or the community house, or the electric fans, or anyone of a hundred devices known to ease the daily toil for workers. Efficiency men will learn these things, and some of them have learned them already, and having learned them, these others, the executive world of industry will be glad to acknowledge the presence among them of this group of men—specialists in the humanities—and to give them free rein in their plants.

So, we all have it within us to go big. We all have it in us to help others go big. We are all bigger and better than we know. From the lowliest machine helper to the biggest industrial owner, we are single units of humanity. Each is a potential force that can rock the earth. Only we don't want to rock the earth. We are all aboard, and all headed the same way, and all getting ours in accordance as we demand it as we go. No one can rule the world and get away with it, unless, like the Nazarene, he tries to rule for the greatest good of the greatest number. Efficiency men have come among us. They have in their hands a great force for good, or a great force for evil. Let them not use this force meanly. Let them go abroad with an attitude that is kindly, with a true sense of justice and proportion, and the result will be a well-defined betterment of all concerned—themselves, their clients, their workable units, *mankind*.

Efficiency By Consent

To Secure Its Active Coöperation Labor Must be Consulted and Convinced in Regard to Changes

By Justice Louis D. Brandeis

Today labor is asking for a voice in its own management. It is therefore especially fitting to republish this address delivered at the Frederick W. Taylor memorial meeting October 22, 1915, in which Mr. Brandeis *laid down the principle that labor must be consulted in regard to industrial changes, convinced that they are right and give its consent before they are put into effect. For in a democratic community men who are to be affected by a proposed change of conditions must be consulted in regard to them.*

Mr. Louis D. Brandeis *is now Associate Justice of the United States Supreme Court. Throughout his professional career as a lawyer he was counsel in many important investigations and cases involving the rights and interests of the public. Thus he was counsel for the people in proceedings involving the constitutionality of the women's ten-hour laws of Oregon and Illinois, the Ohio nine-hour law, the California eight-hour law, and the Oregon maximum wage law of 1914. He was active in preserving the Boston municipal subway system; in establishing the Boston sliding-scale gas schedule, and in furthering Massachusetts savings bank insurance.* Justice Brandeis *has been on the Supreme Court bench since 1916.*

IT was Taylor's purpose to make the laborer worthy of his hire; to make the hire worthy of the laborer; to make the standard of living and the conditions of working worthy to be called American. The American standard of living implies a wage adequate for proper housing and food and clothing, for proper education and recreation and for insurance against those contingencies of sickness, accident, unemployment, premature death or superannuation, which fall so heavily upon the working classes. That standard implies hours of labor sufficiently short to permit those who work to perform also their duties as citizens and to share in the enjoyment of life. That standard implies postponement of the working period to an age which enables the child to develop into a rounded man or woman. That standard implies working conditions which are not only consistent with the demands of health and safety, but are also such as may make work for others what is was for Taylor—the greatest of life's joys.

Taylor recognized that in order to make such a standard of living and of working attainable, the productivity of man must be greatly increased; that waste must be eliminated, and particularly the waste of effort which bears so heavily upon the worker. And yet the man who sought to so develop industry as to enable labor to reach these higher standards of working and of living, met, throughout his life, wide-spread opposition from those whom he sought particularly to help. Let all who are undertaking to carry forward his work recognize this hostility as a fact of fundamental importance; for it presents the main problem which confronts scientific management.

The causes of this hostility are twofold:

First. Only a part of the necessary industrial truths have been as yet developed.

Second. The necessary assent to the application of these truths has not been obtained.

Labor Must Be Conserved and Developed

Taylor was a great scientist. He established certain truths, fundamental in their nature. But he obviously covered only a part of the field of inquiry. The truths he discovered must be further developed and they must be supplemented by and adjusted to other truths. The greater productivity of labor must be not only attainable, but attainable under conditions consistent with the conservation of health, the enjoyment of work, and the development of the individual. The facts in this regard have not been adequately established. In the task of ascertaining whether proposed conditions of work do conform to these requirements, the laborer should take part. He is indeed a necessary witness. Likewise in the task of determining whether in the distribution of the gain in productivity, justice is being done to the worker, the participation of representatives of labor is indispensable for the inquiry which involves essentially the exercise of judgment.

Furthermore, those who undertake to apply the truths which Taylor disclosed must remember, that in a democracy it is not sufficient to have discovered an industrial truth, or even the whole truth. Such truth can rule only when accompanied by the consent of men.

We who have had occasion to consider the hostility of labor leaders to the introduction of scientific management, know that the hostility has in large measure been due to misunderstanding. Much of all the waste which Taylor undertook to eliminate, has no direct relation to the specific functions of the workingman. It deals with waste in machinery, in supplies, in planning, in adjustment of production and distribution—matters in which changes cannot possibly affect the workman injuriously. And yet we found in many leaders of labor undiscriminating opposition to the whole of the so-called Taylor system. But even if we succeed through education in eliminating the general hostility to the introduction of scientific management in departments of the business which do not directly affect labor, there will remain a wide field where the proposed changes do directly affect labor in which there is determined opposition. This opposition can be overcome only through securing the affirmative coöperation of the labor organizations.

Labor Must Be Convinced That Industrial Truths Are Human Truths

In a democratic community men who are to be affected by a proposed change of conditions should be consulted, and the innovators must carry the burden of convincing others at each stage in the process of change that what is being done is right. Labor must have throughout an opportunity of testing whether that which is being recorded as a truth, is really a truth, and whether it is the whole truth. Labor must not only be convinced of the industrial truths—which scientific management is disclosing—but must also be convinced that those truths are consistent with what may be termed human truths. Is the greater productivity attained clearly consistent with the health of the body, the mind and the soul of the worker? Is it consistent industrial freedom? Is it consistent with greater joy in work, and generally in living? These are questions which must be answered in the affirmative, and to the satisfaction, not of a few merely, but of the majority of those to be affected.

Labor Consent and Coöperation Must Be Obtained

To do honor to Mr. Taylor and to worthily carry forward his work, those who are his disciples, and those who may become such, should recognize that they have in the solution of these questions a call upon them for patient effort, no less exactly and severe than that to which Taylor subjected himself when pursuing the law of cutting steel. Every step in the installation and the working out of scientific management calls for such coöperation by representatives of labor. The obstacles to securing it are great. Twenty-five years may be required to remove them fully. But whatever the time required to fully convince organized labor, it must be given, if our work is to be well done. The consent and the coöperation of the worker so represented must be secured. In no other way can we attain in full measure the increase of productivity upon which our well-being so largely depends. In no other way can we secure that joy in work without which increase of productivity will not bring greater happiness. In no other way can we attain that freedom and development of the worker without which even his greater happiness would not promote the general welfare. Let us work unremittingly in the spirit of Taylor to solve the problem he left unsolved. In the solution of that problem—which in a true sense is the labor problem—the greatest honor will be done to his memory and the greatest service to mankind.

The Employees' Benefit Association—II.

Its Relations to Employee and Employer and Its Management

By W. L. Chandler

In this installment the author states and answers from experience sixteen problems connected with the establishing and operation of an employees' benefit association. The questions concern the financial affairs of the association, the qualifications for and the limitations of membership, and the duties and responsibilities of the officers.

Mr. W. L. Chandler *has had experience in every department of the plant where he is now assistant treasurer, The Dodge Manufacturing Company. Of late years he has specialized on the study of employees' relations. He has been identified with many local and national movements, and was chairman of the Danger Emblem Committee of the National Safety Council.*

THE employees' benefit association is of and for the employees. Then why not let them run it themselves, confining our efforts to giving them the benefit of our experience to guard against inefficiency and mistakes? Those who have followed the data and suggestions given in the first group of problems presented in Industrial Management for January have no doubt reached the conclusion that the association should be managed either jointly by employees and employer, or by the employees with the fullest coöperation of the employer in the form of counsel.

In my opinion the *association should be of, by and for the employees.* The returns to the employer are of such a nature that they cannot be weighed or measured. In fact, these returns come in proportion to the cube of unselfishness which we put into our efforts to help boost the interests of employees in the association.

The succeeding four groups of problems to appear in later issues of Industrial Management deal with benefits, rates of dues and the measuring of results.

The problems presented in this installment must be considered first because of their bearing upon those to come later. Some of the charts appearing in this group will be referred to in subsequent groups.

Problem Number 14

Should the Payment of Benefits Be Guaranteed by the Employer?

In 13 per cent. of the associations investigated the payments of benefits is guaranteed by the establishments. The bulk of these are managed either by the establishments or by the employees and establishments jointly.

Where guarantees are given, they are sometimes conditional upon the members observing the rules governing the associations, or upon the handling of all the moneys by the establishments themselves, etc.

In helping to start a new association the employer might feel like guaranteeing its success. On the other hand, the initiation or membership fees should be enough to start it successfully.

The association should be operated with rates great enough to avoid the need of assessments, without at the same time having excessively high rates.

Employees should have confidence in the safety of the Association, and if rates are right, the guarantee will serve only to emphasize safety. There are other and better ways of creating and maintaining confidence which are covered under various problems, but if rates are safe, the establishment may well guarantee results.

My opinion is that a guarantee is not necessary to create confidence if the work of promotion has been properly handled.

Problem Number 15

Should An Association Incorporate?

This question of incorporation may be decided differently in different states. Any one wishing to secure accurate information on the legal points involved should consult an attorney. So far in the writer's search nothing has been found to indicate that incorporation is legally necessary or even particularly advantageous. There seem to be few legal decisions, but enough are available, however, to indicate the status of an association at common law.

Associations are considered to be legal whether incorporated or not, and decisions are usually based on their constitutions and by-laws.

It has been held that benefit associations are not insurance companies in the usual meaning of the term, and are not subject to the restrictions of the insurance laws, and that they may be operated by establishments for the benefit of their employees and themselves.

It has also been held that associations are not partnerships unless made so by statute, and that they cannot be classed as charity or benevolence.

Members of an unincorporated association cannot sue the association for an act of tort committed by its officers or employees. This even applies to malpractice of association physicians which can only be charged against the physicians themselves.

When incorporated, the status of the association is changed, but the law will fix the responsibility according to the circumstances of incorporation.

Less than half the associations are incorporated.

Associations may find it advisable to eliminate the word "Insurance" from their by-laws and documents to avoid the possibility of some technically inclined person construing it to be subject to the insurance law.

Problem Number 16

How Should An Association Be Financed?

The plan in general use seems to be to look to the members to carry all or part of the expense. The cases where the establishments bear the entire expense seem to be confined principally to accident associations covering accidents while on duty only, or in a few cases to employers who, through generosity, as a raise in pay, or (as in one case) to shut out a union, have absorbed the expense.

Twenty-nine per cent of the establishments contribute to the associations various amounts which cannot be tabulated in a way to be of any service. The average annual contribution amounts to $1.81 per member of the associations which receive such assistance.

According to the plans proposed for compulsory health insurance, the employer is expected to contribute a percentage of the cost of operation as representing the contribution of the industry toward caring for those employed in it. The employee is expected to contribute his share and the state is supposed to pay a smaller portion as representing the general responsibility of society, and to give the state greater rights in the control of the associations.

If the employer allows the officers of an association to transact the business of the association on company time, the members should carry the balance of the load. In fact, they may ask what the employer expects to get out of it if he offers to carry their burden as reflected in the cost of benefits. Labor does not count the cost of clerical help and will not raise any question regarding the time the officers put in on association activities.

Chart 2 shows the distribution of income, and outgo, in an average healthy association. Mercantile transactions embodied the sale of books and other merchandise. The cost of the merchandise appears below and the amount realized from sales is shown above. The profits on these sales paid all expenses of the association.

The Dodge Manufacturing Company allows the officers to transact the business of the associatoin on company time, so that this expense is not included.

Dues greatly exceeded the amount needed for benefits of all kinds. Mercantile profits are placed to the credit of an emergency fund, which may be used as occasions demand without influencing the soundness of the association, as might be the case if the general fund was used for emergencies not covered in regular benefits.

Amounts have been loaned to members financially embarrassed by long drawn out disabilities. This form of a loan sometimes involves considerable risk, although thus far no losses have been sustained in that way.

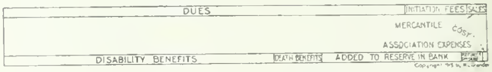


CHART 2. RELATION OF INCOME AND OUTGO FOR A RELIEF ASSOCIATION, 1915

Dues should be sufficient to cover all losses and expenses and also permit of dividends occasionally.

Problem Number 17

Should There Be More Than One Class of Members?

Thirty per cent of the associations have more than one class of membership. Of these, 16 per cent. use age as a basis; 72 per cent. use wages; 8 per cent. use sex, while conjugal conditions, occupation, physical condition, amount of benefits desired, adults and apprentices are other factors. Some associations use more than one basis. Where dues were a uniform percentage of wages, the members were not considered as classed into groups. Associations collecting uniform dues but paying varying benefits are not included above.

So long as the disability benefits from all sources do not exceed, say 90 per cent. of wages, an employee should be encouraged to insure up to say 66⅔ per cent. of his wages. This can be arranged by different classes, or by unit memberships of which members may select the ones which best suit their needs. (See Dodge By-Laws, Art. VIII, Sec. 3.)

Sec. 3. The regular dues each two weeks or half month pro rata shall be determined by the benefits which the member elects to take as follows:

A. Temporary disability benefits not to exceed thirteen weeks for one disability, nor more than twenty-six weeks in any one calendar year	1 Unit	2 Units	3 Units	4 Units
Benefits for each week day after the first three days	$ .50	$1.00	$1.50	$2.00
Amount of dues per week for this benefit	.05	.10	.175	.25
B. Death of Member				
Benefit to be paid at death of member	50.00	100.00	150.00	200.00
Weekly dues for this benefit	.015	.025	.045	.06
C. Death of wife of member provided she lived in the United States at time of her death	50.00	100.00	150.00	200.00
Weekly dues for this benefit	.03	.05	.09	.12
D. Death of dependent child over 2 years and under 16 years of age				
Benefits in excess of $50 may not be taken for children under 6 years of age				
Benefits to be paid for each child at death	25.00	50.00	75.00	100.00
Weekly dues for each child	.02	.04	.06	.08
E. Club benefits, including use of club rooms and such privileges as go with them				
Weekly dues and privileges				.05

In the Dodge Association, the experiment was tried of making no effort to influence the amount of insurance taken. During this experiment, 591 new members joined and of these the percentages indicate that compensation laws meet the popular fancy when they provide from 50 to 60 per cent. of wages for disability.

Sales efforts show that men may be influenced to insure more adequately than if left to themselves.

Graduated dues and benefits should be provided to permit flexibility.

PROBLEM NUMBER 18

SHOULD AGE LIMITS BE ADOPTED AS CONDITIONS OF MEMBERSHIP?

Forty-four per cent. of the associations report no minimum age limit; 9 per cent. have 14 years; 16 per cent. have 16 years; 20 per cent. have 18 years; and 5 per cent. have 21 years; while the balance (6 per cent.) range from 10 to 20 years.

Associations frequently fix minimum age limits higher than the employment age limits of the establishments. I cannot see the justice in this practice.

No minimum age limit should exist. If a person is old enough to work and pay dues, no restrictions should be placed in his way. Young members are the life of an association and it will prosper directly in proportion to the percentage of its young members. While every effort should be made to secure young members, it is unfair to unduly hamper older applicants.

Twelve per cent. of the establishments where associations exist, report maximum age limits for employment, ranging from 35 to 65 years. Of this number, 24 per cent. of the associations have a limit of 45 years; 42 per cent. have 50 years; 18 per cent. have 60 years; while the balance (16 per cent.) are scattering.

While only 12 per cent. of the establishments report maximum age limits for employment, 38 per cent. of the associations have maximum age limits for admission to membership. In these the limits range from 35 to 70 years as follows: 21 per cent. at 45 years; 41 per cent. at 50 years; 16 per cent. at 55 years; 16 per cent. at 60 years; and the balance (6 per cent.) scattering.

Some employees join an association while young and not only create a reserve to a small extent in the association treasury, but by contributing their share toward the relief of their fellows during their earlier years, are entitled to the fullest consideration when they reach old age.

On the other hand, some employees do not join until they begin to feel the pinch of sickness and the infirmities of old age coming on. These fellows have created neither financial reserve in the association treasury nor coöperative moral obligation of members, so they should not expect the same consideration which their more provident fellows receive.

It is usually feasible to vary the amount of dues for those joining the associations at different ages, but the benefits may be reduced in cases where the member does not join the association before reaching some specified age. See Article VIII, Sections 8 and 9 of Dodge By-Laws.

Section 8. Members who join the association after they are 45 yearfs old, shall receive benefits as follows:

Age at time of joining.	Benefits will be
46 to 50	10% less than regular schedule
51 to 55	20% " " " "
56 to 60	30% " " " "

Section 9. Nothing in Section 8 of this Article shall affect the benefits due under any membership taken before member reached the age of 46 years and kept continuously in force thereafter.

Charts 3 to 11 inclusive, page 112, indicate the influence of age upon sickness, accident and death as reflected in experience of two years in the association at the Dodge Manufacturing Company. Those of even numbers are meant to show how the results might have appeared if all ages were equally represented in the membership.

In such cases the mean membership line would be straight and the fluctuations of the other lines emphasize the relations of the various ages to the normal line. If sickness and accident results were exactly uniform for all ages all lines would coincide.

Results of the year 1915 indicate that younger members are more susceptible to both sickness and accident, but 1916 results rather indicate that age has little, if any, effect upon sickness and accidents. The membership during 1915 was fluctuating greatly due to large increases in the number of younger members. The membership during 1916 was much more stable as to age groups and therefore may be taken as a safer guide.

Insofar as one may judge from this chart, at least, we may conclude that younger members are less hazardous from the standpoint of death losses. That is a reasonable conclusion. Hence younger members appear to be such that we may class them as very desirable.

It may later be found possible to remove all distinction as to ages over 45, although it seems proper to discriminate against those who will not do their share in younger years.

PROBLEM NUMBER 19

SHOULD APPLICANTS SUBMIT TO MEDICAL EXAMINATION?

In 18 per cent. of the associations medical examinations are compulsory, and in 3½ per cent. the option rests with the association. One establishment offered to pay into the association treasury an amount equal to the dues collected, provided the medical examination was waived, and provided further that the association increased its membership to 75 per cent. of the total payroll, exclusive of the office force.

Two advantages of medical examination appear as possible: The saving to the association in eliminating risks which may prove costly, and the ability to catch some cases of incipient disease in time to save some cost in treatment. The cost of treatment such as this should be borne by the incoming member as the association might not be willing to pay benefits due to a disease contracted before admission.

Another benefit comes through the knowledge thus acquired of the health of many employees in time to help them and to protect their fellows against contagion.

If preventative measures are to be considered, medical advice on some feasible plan is quite necessary. Visiting nurse associations are open to contract for work which is of help in this direction, and sometimes the physicians may be similarly interested.

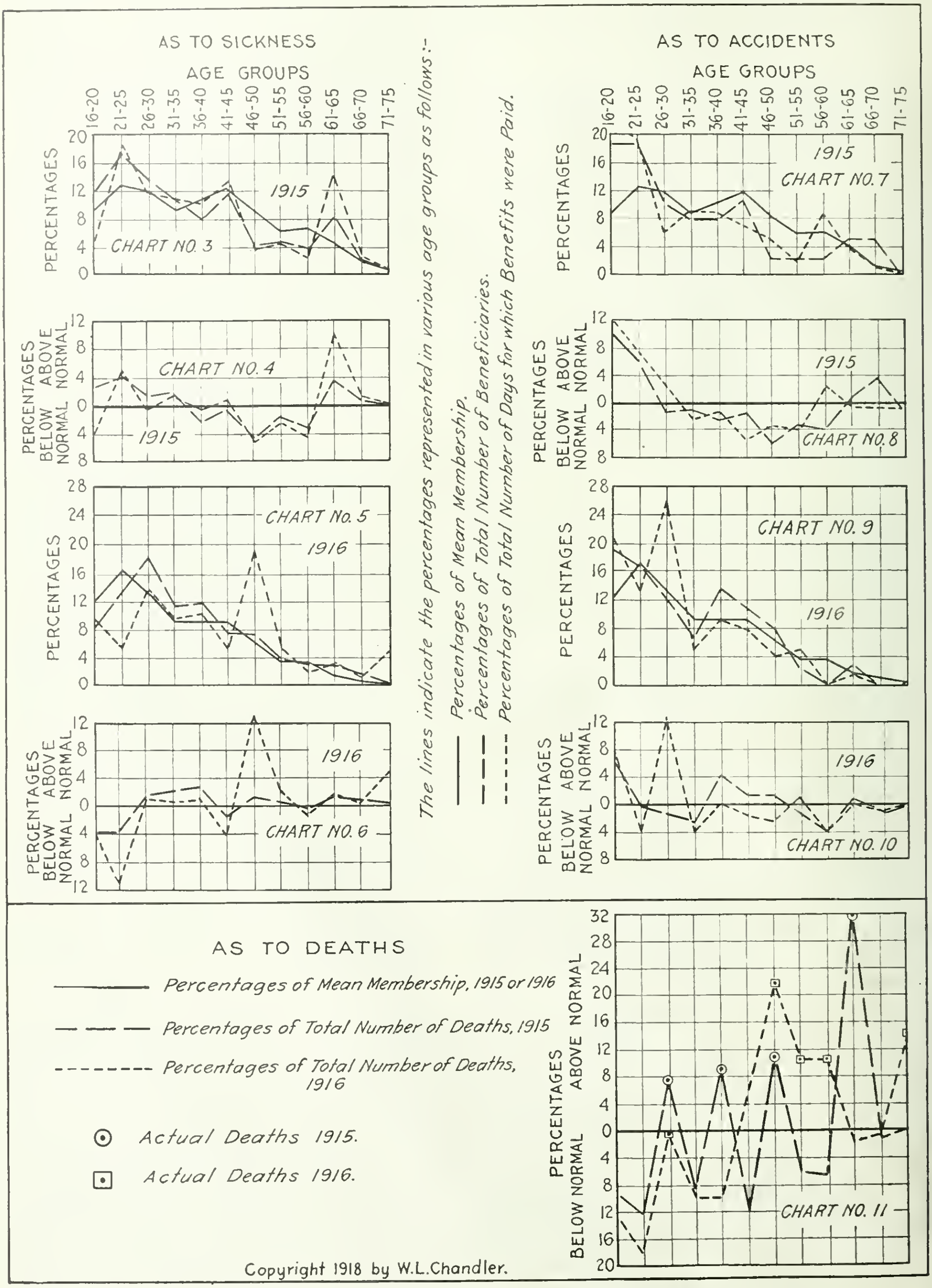
PROBLEM NUMBER 20

SHOULD AN EMPLOYEE BE ELIGIBLE FOR MEMBERSHIP WITHOUT RESTRICTION AS TO PERIOD OF EMPLOYMENT?

Sixty-nine per cent. of the association admit new employees without restrictions as to periods of employment; 11 per cent. require 30 days' employment prior to eligibility; 2½ per cent. require 60 days; 8½ per cent. require three months; 2½ per cent. require six months; while the balance range from three days to six weeks; except one association (under joint management) which requires an employee to work two years before becoming eligible for membership.

The main object I can see in requiring an employee to wait a specified time before becoming eligible for membership is to enable the association managers to acquire some knowledge along lines of the moral hazard, but this seems to be of very doubtful value. The physical condition can be determined largely by an examination and the malingering and other traits will only develop after membership anyway, except in a few cases.

When a man is hired is the psychological time to bring before him the suggestion that he join the asso-



CHARTS 3 TO 11. INFLUENCE OF AGE UPON SICKNESS, ACCIDENT AND DEATH

ciation and the sales effort necessary is very much less than at the end of thirty days or longer. A lower membership fee for the first month after employment will do much to avoid procrastination, because it offers a bonus for prompt decision and establishes a time when a man will reach a decision.

A reduced price for a limited time has sales advantages which are quite generally known. See Dodge By-Laws, Article VIII, Sec. 2.

Section 2. In lieu of membership fee, the dues of each member for the first fourteen weeks after joining shall be twenty cents per week in addition to the regular dues, except that applications received from employes within one month after employment begins, or within one month after the adoption of these by-laws, shall entitle them to special dues for the first fourteen weeks of ten cents per week, in addition to the regular dues.

Problem Number 21

Should a Member in Accepting Benefits Release the Establishment From All Claims for Injury or Death Due to Work Accidents?

A number of associations (usually supported at least in part by the establishment) include in the blank application for membership, to be signed by the applicant, a clause providing that the acceptance of benefits from the association shall operate as a release from all claims against the establishment for damages arising from injury while on duty at the establishment, and that the rights to benefits shall be forfeited by the bringing of a suit. In a few instances, the applicant signs an agreement that he will accept the benefits from the association, and that he will not bring suit against the establishment.

Where such a release clause is used, the receipt for benefits signed by a beneficiary contains a release against any claim for damage against the factory.

State laws relating to employers' liability and workmen's compensation have a direct bearing upon this question.

It is not intended to go deeply into legal matters here, as they should be put up to competent counsel in each state, but certain things of interest have appeared.

The laws in most states do not specifically prohibit such releases, except as they may be affected by employers' liability, workmen's compensation and similar acts. Agreements to waive benefits where suits are filed have been declared reasonable under liability laws on the ground that they are contracts to choose one of two forms of redress, only one of which would exist but for the organization of the benefit association.

The fact that the employee contributed in part to the association seems to make little difference, but the establishment must show in all cases a mutuality of obligation and contribution to the association by the establishment.

It is not the contract made prior to the injury that bars action, but acceptances of benefits or some other significant action after injury.

A contract referring all claims to an association's advisory committee has been condemned when the findings of the committee are to be final.

Contracts releasing the establishments from claims when benefits are taken, really provide against taking both forms of redress. They relate only to the association and do not limit the right of the injured to refuse benefits and take action against the establishments. Some states have laws prohibiting such contracts.

If the association is operated as a mutual insurance provision without contribution by the employer beyond the time consumed by the officers, the benfits should be in addition to any compensation allowed by law, provided the total does not exceed 90 per cent. of wages.

Problem Number 22

Will a Well Employee Produce More Than a Sick One?

So far as I know, there are no accurate statistics to show that production bears any relation to the health of employees, and yet it seems that if the entire force was sick to such an extent that they could but little more than hold their jobs, the production would be vastly less than if through some medium the entire force could be relieved from their malady and brought to feel like working enthusiastically.

If that be true, it follows that any improvement in the health of employees has some effect on production.

Having reached such a conclusion, the next step is free medical service and the employees' benefit association in its fullest development.

Problem Number 23

Should Employees Leaving the Establishment Be Permitted to Retain Their Membership in the Association?

(a) When "laid off."

(b) When they leave permanently or are discharged.

Forty-one per cent. of the associations make some sort of provision for employees leaving the establishment. These are associations managed either by employees or jointly by employees and the establishments.

Eighteen per cent. of the associations extend privileges unconditionally to members who have left the establishments; 10 per cent. require them to reside in a prescribed locality. The remaining 13 per cent. have different restrictions, such as allowing membership only for periods of from ten days to one year; or, until next dividend or other fixed date. Some of them make distinctions in favor of those who were charter members, or those who were members for periods ranging from three months to five years. Some of them charge those leaving the establishment extra dues, the highest being double the regular amount.

Some prohibit certain occupations for this class of members, such as those of more hazardous nature, liquor business, etc.

A few associations will not allow members who are not employees to vote, and some will not allow members who are not employees to hold office. One association shuts out women who leave to marry, another cuts pensioners from sick benefits.

One requires members to keep up death and expense assessments; one requires extra dues; one allows them to continue only until the following January (when the reserve in the treasury is divided); one allows employees to continue who are unable to work and who have been with the establishment five years prior to leaving; one has same arrangement of the ten year employments; one extends the privilege to employees of one year or more standing, while another gives half of the death benefit and free medical advice for six months provided the one leaving has been a member for three years; or full death benefit and free medical advice for six months, provided the one leaving has been an employee for five years and a member three.

It is understood that dues and assessments are to be kept up in all cases. Certain associations allow accident benefits only when injured on duty, so it is evident that the protection is not always complete in cases of employees who have left the establishments.

One association, which cannot supply a copy of its by-laws, reports that two-thirds of its sick benefits go to "outside members," while these outside members constitute only one-third of the total membership.

There is quite a distinction between employees who are "laid off" on account of lack of work, and those who leave to seek employment elsewhere, but unless the member remains within the district where the association officers may readily keep in close touch, the expense of supervision becomes too high for this form of insurance where expenses are supposed to be largely eliminated.

One method of solving this question is seen in the by-laws of the Dodge Mutual Relief Association, Article III, Sections 6, 9 and 17, and Article VIII, Sections 5, 6, 7, 12 and 17.

Section 6. Connection with the association shall terminate when the member ceases to be employed by the Dodge Manufacturing Company or its subsidiaries, or when suspended or expelled by order of the Directors, in accordance with the by-laws, or upon resignation filed with the Secretary, except that where a member shall be temporarily laid off by the Dodge Manufacturing Company or its subsidiaries, such action shall be held subject to the discretion of the Directors to not terminate the membership until twenty-six weeks have elapsed, provided dues are handed regularly to the Secretary without solicitation and the member continues to reside in the county.

Section 9. Membership shall date from the time of deducting the first dues from the wages of applicants and shall terminate with the expiration of the time covered by the last dues paid.

Section 17. Membership shall cease when for any reason dues are not paid as provided in the by-laws unless by the consent of the Board of Directors.

Section 5. When no wages are due a member from the Company, dues must be paid when due, without solicitation from the Secretary in order to retain membership, except that in event of a member otherwise eligible for membership being temporarily laid off by the Company, the Directors, upon request and satisfactory assurance of credit responsibility, may arrange to extend the membership for a period not to exceed thirteen weeks, when the amount in the treasury will warrant it and on condition that all such accrued dues are to be deducted from any benefits paid until the accrued dues are paid up.

Section 6. When members had been laid off temporarily, and then resume work after having had the advantages of protection as covered in Section 5, whether receiving benefits or not, their dues shall be doubled until all indebtedness to the association has been paid.

Section 7. The provisions of Sections 5 and 6 are available only to members who continue to reside in the same county, and do not take up any occupation, which, in the opinion of the Directors, should enable them to pay their dues, or should warrant the association in cancelling the membership.

Section 12. Members desiring to leave the county while drawing disability benefits, must arrange satisfactorily with the Directors for further and sufficient proof of disablement, or surrender all rights to further benefits.

Section 17. Should a member be discharged by the Company while drawing disability benefits, he shall not forfeit his rights to such benefits unless the Directors learn that the discharge was for misconduct; when the benefits shall cease not later than the expiration of one month from his discharge, subject to the judgment of the Directors.

Problem Number 24

Should An Association Provide for An Actuarial Examination?

The Department of Labor, which furnished much of the data from which these figures are taken, reports that an inquiry disclosed the fact that very few associations have had an actuarial examination or have provision for one in their constitution.

This seems to be a very important matter, and a scrutiny of the figures from which these data are compiled shows quite an opportunity for improvement through actuarial guidance, and through a comparing of actuarial experiences between associations.

The association may be able to select some member as its own actuary who has sufficient experience and grasp of the insurance factors to guide the officers properly. Failing in that, however, or perhaps as a means of checking their experience, it may be desirable to consult an experienced actuary annually.

As a guide in this direction, it will be well to open accounts with each of the various lines of benefits, such as disability, death of members, death of wives, etc. These should serve as controlling accounts, be credited with dues received for each purpose and be charged with the benefits paid on each class of claims.

Subsidiary accounts may well be carried with each of the separate classes or units of these benefits, and records should be so kept that at any time one may determine the relation between sickness and accident. Checking one department of a plant against another may disclose need for remedying the cause for some disease or accident arising in the course of employment.

If the associations kept accounts on a uniform plan, it would be very easy to compare notes and judge of the success or safety of any division of benefits.

A federation of associations or some central national clearing house would prove a big factor in exchanging such data.

Problem Number 25

Should An Association Have Officers as Listed?

(a) President.
(b) Vice-president.
(c) Secretary.
(d) Financial secretary.
(e) Actuary.

Thirteen per cent. of the associations have no president. Of these, 15 per cent. are operated by employees, 45 per cent. by establishments, and 40 per cent. jointly. Twenty-three per cent. have no vice-presidents, 4 per cent. have two, while two associations have three.

Fifty-nine per cent. of the associations have separate secretaries and treasurers, while in 12 per cent. these offices are combined.

Fifteen per cent. of the associations have an additional financial secretary. One has a secretary and a financial secretary, but no treasurer, and one has a president-treasurer.

Twenty-one per cent. of the associations do not have the office of treasurer.

It is not important that an association have a full complement of officers, but it is a good idea to have several men experienced in the management of its affairs and the offices afford an opportunity to give the training necessary.

The secretary should be the life of the association, and one should be provided. While he must be subject to the will of the board of directors, he, at the same time, must, every day, exercise discretion in carrying out the work of the association under the direction of the board.

The employer should be willing to allow some individual selected by popular vote to act as secretary of the association on "company" time.

In fact, if the employer has in mind a man capable of filling this important office, he may well let it be known that his services are available if wanted. The members will know whether the man is the sort they want. If he is, they will welcome the suggestion, and if he is not, they will not want him, and it would be unwise to force him upon them.

There is no use trying to operate unless the secretary is free to prosecute the work at such times as circumstances require. Only certain employees are so placed as to be able thus to leave their work when occasion demands. The work of an association of five hundred or more members may take most of a man's time.

The greatest opportunity for the employer to offer advice and keep in touch with the success of the association is by the election or appointment by the board of an actuary. His duties should be to supervise the statistical work and point out any unsafe practices, or show what may safely be done to increase membership and render greater service to members.

An accountant may be pessimistic and is not necessarily a good actuary. To fill this office properly, one must have his heart in the work and be able to see the entire proposition from all viewpoints. The actuary should be chosen with great care.

Section 13. The duty of the Actuary shall be to keep informed on all actuarial matters of interest to the association, and exchange actuarial information with similar officers of other associations for the general good of this association.

Section 14. He shall give advice to the Directors on the safe conduct of the financial affairs of the association, and to members, covering such information as he may have or be able to secure, referring to any insurance or financial matters submitted to him.

PROBLEM NUMBER 26
HOW SHOULD OFFICERS BE SELECTED?

The president is elected by the members in 74 per cent. of the association; by the managing boards in 8 per cent.; by delegates in three associations, and by heads of departments of the establishments in two associations; he is appointed by establishments in ten, and designated by constitutional provision in six.

In 73 per cent. of the associations the president must be an employee; in 5 per cent. he must be an establishment official; while 6 per cent. specify that he may be either. Others have no provision.

In 12 per cent. of the associations the treasurer must be an establishment official; in 58 per cent. he must be an employee, and in 6 per cent. he may be either. Others have no provision.

The number of associations managed by employees in which any of the association officers are also officers in the establishments, is comparatively small. In the case of association under joint management, it is very common for officers in the establishments to hold important offices in the associations.

In many establishments, some employees who are in close touch with the officials of the establishments are elected by the members, either because the impression has gone out that the establishments would welcome such action or that the particular employees by virtue of their positions, experience and abilities, are well suited to fill the offices to which they are elected.

Nominations for office, as a rule, are made in open meetings; a few associations require nomination to be made previous to the meetings at which the elections are held. The ballot is the usual method, but occasionally *viva voce* votes are taken.

It is not material whether an association officer is an employee or an official or appointee of the establishment. The most important thing is to have only such officers as will command the respect of all employees, and as are capable of filling the offices in a business-like manner.

Employees will soon determine whether the officers are operating for their best interests. If they are, satisfaction follows; if not, something must be done at once to save the association from failure, for although employees continue membership, the real asset to the employer—loyalty and enthusiasm— are gone, and the association is, from the employer's standpoint, a failure.

For that reason, it is important that only the popular voice be heard in selecting officers, provided care be exercised to see that no internal machine be created by designing members to bring about disastrous results to both association and employer.

PROBLEM NUMBER 27
SHOULD OFFICERS RECEIVE SALARIES?

Sixty-six per cent. of the associations pay the secretaries and treasurers small salaries directly from the treasuries of the associations; in 8 per cent. these officers are paid by the establishments; five associations have a joint arrangement with the establishments; and in a few cases these officers are relieved of the payment of dues, assessments, etc., in lieu of salaries.

For psychological reasons, it may be well to provide a nominal salary for secretary and treasurer from the association's treasury, but in an ordinary case, a few dollars per year will give the needed results if the work is handled on "company time" and the men selected have it in them to be interested in the work.

Five or ten dollars per year in addition to salaries received from the employer will usually serve admirably in cases where the bulk of the work is performed on company time.

PROBLEM NUMBER 28
SHOULD OFFICERS BE BONDED?

In 62 per cent. of the associations officers are bonded in sums ranging from $50 to $20,000. In 39 per cent. of the associations the treasurers are bonded; in 54 per cent. the secretaries; in 11 per cent. other officers such as president, vice-president, financial secretary, trustees, etc., are also bonded.

For the sake of the effect on all concerned, it may be well to bond the secretary and the treasurer or the officers handling the money and claims.

With the secretary under bond, and his signature necessary on checks, in addition to that of the treasurer to withdraw funds, one bond may be made to suffice, but no convenient plan appears to provide a check (except through the auditing committee) on the handling of dues and claims by the secretary, so that a bond on his services seems desirable.

PROBLEM NUMBER 29
HOW SHOULD MONEY IN THE TREASURY BE HANDLED?

In 65 per cent. of the associations managed by employees, the moneys are deposited in bank; in 9 per cent. they are deposited with the establishment; in others, they are invested in building and loan associations, in stocks and bonds, or in stock of the establishment.

In 78 per cent. of the associations managed by the establishments, moneys are held by the establishment; in four associations they are deposited in the bank.

In 49 per cent. of the associations managed jointly, the moneys are deposited in banks; in 33 per cent., held by the establishments, and in two associations, invested by or with the approval of the managing board. In a few associations, surplus moneys were invested in the stock of the establishment.

Generally, disbursements are made on orders signed by one or more of the officers, by a managing board, by a relief committee or by a finance committee. Sometimes the treasurers' checks must be countersigned by certain designated officers.

In nearly every association accounts must be audited at stated intervals.

In many cases, employees are apt to misunderstand any suggestion to turn the funds over to the establishment either with or without interest and, unless local conditions are particularly auspicious, it will be advisable to let them deposit their funds in the bank or invest their surplus in safe securities largely of their own selection. The advice of the employer may be welcome in this connection.

Poorly Packed Freight—Is It Yours?

Railroads Have Troubles Enough, so Do Not Use Flimsy Boxes and Crates

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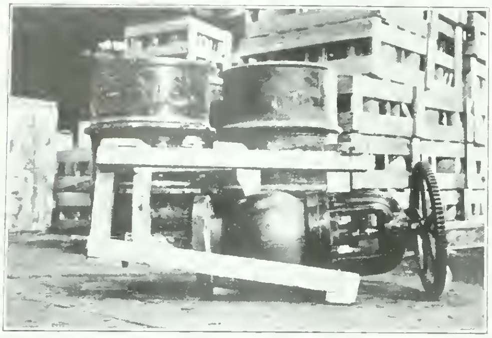

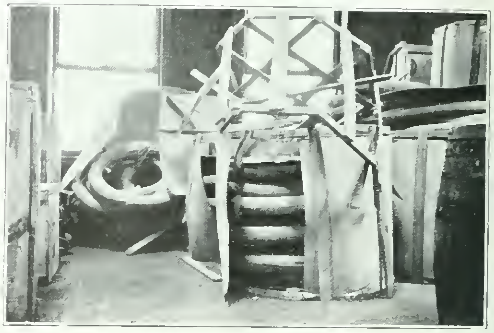

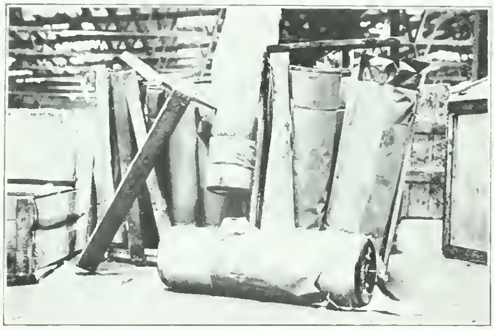

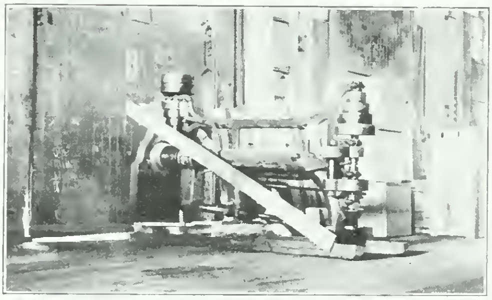

Factory Lighting Codes and Rules

A Review of Progress, and the Regulations of Wisconsin, New York, Pennsylvania and New Jersey

By C. E. Clewell

Legislation to fix the amount of artificial light provided in industrial plants has been passed only during the past three or four years and then only in a few states. But this is real progress and the greatest advance has been made in 1917. To insure satisfactory working conditions employers cannot fail to provide the minimum intensities of light required by these rules—production during the winter months and at night depends upon it.

Professor C. E. Clewell, *assistant professor of electrical engineering at the University of Pennsylvania, received his technical education at Lehigh. He was then employed by the Westinghouse Electric and Manufacturing Company, and became one of the lighting experts of that firm. He left that work to undertake the teaching of electrical engineering in Sheffield Scientific School at Yale and gave up that work about three years ago to take up his present duties.* Professor Clewell *is an active member of the Illuminating Engineering Society, and was chairman of the Committee on Factory Lighting which drafted that Society's industrial lighting code.*

In the remarkable developments which have taken place in the factory lighting field during the past few years, there are two outstanding items which are most significant from the standpoint of management. The one is the emphasis which has been given to the relations of adequate lighting to factory production, that is, the beneficial effects of good lighting on the time saved in factory operations, on the accuracy of workmanship, on the eyes of employees, and other similar features. The other is the marked impetus which has been given to industrial lighting legislation. This article takes up somewhat in detail this second item, reviewing briefly the steps which have led to the present legislation and pointing out the important developments in this field during the year 1917.

EARLIER RULES INDEFINITE AND INADEQUATE

A study of factory legislation as it existed in the various states only a few years ago shows, first of all, that but little attention was given to the question of suitable artificial light as an important part of the industrial environment, and that in those few scattered cases where references to lighting were made in such enactments, they were almost uniformly unsatisfactory and indefinite.

For example, in a summary of all the industrial legislation in the State of Pennsylvania prior to 1916 wherein references to lighting were made, in not one instance was the reference couched in such language that the rule could be definitely followed or enforced. In other words these references were of that class where the lighting requirements were referred to as "good lighting," "well lighted," and the like, and obviously those who attempted to follow such terms were confronted first, with the necessity of interpreting the meaning of "good" as applied to lighting and, second, with the uncertainty of knowing whether their own assumption of the exact requirements would correspond with the ideas of the factory inspector who happened to visit the premises.

It is perhaps obvious that this condition has existed in the immediate past because of a lack of general understanding of the exact requirements of factory lighting and has, therefore, been due not so much to oversight as to lack of information of the best manner in which to make up the specifications. With the increasing attention which has been given to the ways and means for improving these facilities, there has been a more or less natural tendency to turn the attention to a corresponding improvement in these legislative specifications with the result that marked changes for the better have been made in at least several of the states during the past three or four years.

EARLY WORK IN WISCONSIN

As early as January, 1913, a move was made in the state of Wisconsin to reduce lighting legislation to a more definite basis. This was one of the first cases in this country where a systematic effort was made in this direction, and some of its features are of special interest in their bearing on the more recent rules which represent still further improvement.

The Wisconsin effort took the form of a series of orders on shop lighting (issued January 20, 1913). The principal characteristic of these orders was the specification of the quantity of light for various operations on a basis of candle-power. For example, order 2102 states in effect that for certain places of work when daylight is not available, artificial light shall be supplied equivalent in amount (for each four square feet of floor space) to at least the light produced by a one candle-power lamp supported 10 feet from the floor.

Several items concerned with this kind of a specification should be noted at this point, not so much in the way of criticism of these original Wisconsin orders but to show why improvements have been considered highly necessary, and incidentally why the Industrial Commission of Wisconsin has found it advisable to take steps during 1917 completely to recast its lighting regulations and abandon the specification as outlined in its original orders.

First, it is unfortunate to base a quantity specification on a unit which may readily be interpreted differently by various people and by the different lamp companies. To illustrate, the Standardization Rules of the American Institute of Electrical Engineers contains five definitions relating to candle-power as follows: 1. The fundamental definition of candle power; 2. The mean horizontal candle-power of a lamp; 3. The mean spherical candle-power; 4. The mean hemispherical candle-power of a lamp; 5. The mean zonal candle-power of a lamp.

Furthermore, while there is now a growing tendency for the lamp manufacturers to rate their lamps, that is, where such rating is in terms of candle-power, on a basis of the mean spherical candle-power, there is still quite a chance for misunderstandings to occur concerning just what kind of candle-power is implied in such ratings for various types of lamps, and where such is the case there is, of course, a corresponding chance for mistakes in the effort to live up to a specification of perhaps one kind of candle-power when another may correspond to the figures furnished by the manufacturing lamp company.

There is, however, another fundamental disadvantage in the use of such a specification as given in the original Wisconsin orders, because it relates to the lamp (the source of the light) whereas the important consideration is that of the *effect* of the lamp or lamps in illuminating the objects to be seen. Thus it is fairly obvious that such a specification of the quantity of candle-power to install per unit of floor area is no guarantee that the light will be directed efficiently to the work, nor that the quantity of illumination on the work will be adequate.

Another method of specifying the number of lamps to install for given purposes, has been based on the watts (consumed by the lamps) per square foot of floor space. In such a case the floor area to be lighted is merely multiplied by the watts-per-square-foot factor and the product is taken to indicate the total watts consumed by all the lamps of the proposed system. Dividing this value of total watts by the watts per lamp of the type chosen, would then show the number of lamps to use.

This method, however, sometimes termed the "watts per square foot" method is as objectionable, and even more so, as that used in the early Wisconsin orders, because it involves the "specific consumption" of the various lamps which may be used. On the face of such a specification it appears that the watts per square foot required to furnish a given value of candle-power would depend upon the number of candle-power produced by the lamp per watt consumed, and that if this latter factor changed, a modification would be required to take into account such variations.

As a matter of fact the candle-power produced per watt or its reciprocal, i. e., the input watts to the lamp per mean spherical candle-power produced by the lamp differs quite widely for various types of lamps and even for the various sizes of a given type. Thus, Stickney gives values for this factor ranging from 1.67 to 1.22 for vacuum tungsten lamps (10- to 100-watt sizes) and from 1.09 to 0.70 for the Mazda-C tungsten lamps (75- to 1000-watt sizes).

Similarly, for arc lamps he gives values as low as 0.31 and as high as 2.07 watts per mean spherical candle-power, depending on the type of arc and the kind of auxiliary globes or reflectors used. These figures show that to employ a specification of watts per square foot much care would be required to take account of the differences in the watts consumed by the lamp per candle-power produced, and as an additional factor almost equal care would be necessary to take due account of the color of surroundings since this will have a very appreciable effect on the amount of light which actually reaches the work from overhead lamps.

As a general proposition, therefore, the writer has felt for several years that the specification of light quantity on a basis of the source of the light is a mistake because of the marked differences in the amount of light produced by various lamps per unit of energy consumed and moreover because such a specification does not take into account the degree with which the light from the lamps is utilized on the work.

Several examples will make this point clearer. Suppose, first, that we assume a given degree of utilization[1] (commonly termed the utilization efficiency of the system) so as to eliminate this factor as a variable from the present discussion. Taking a value of 40 per cent. for the factor and assuming that an intensity of four foot-candles[2] is required at the work, we may specify in the following ways the requirements for the number of lamps to install.

One watt per square foot; 0.8 mean spherical candle-power per square foot; ten generated lumens[3] per square foot; or about one mean horizontal candle-power per square foot.[4] These values show, then, some of the different methods which might be used to specify the quantity of light at the source for a given type and size of lamp and a given utilization efficiency.

Going a step further, suppose we assume as before that the intensity at the work is to be four foot candles and the utilization efficiency 40 per cent., then for various types of lamps we have the following figures (roughly) for the *watts per square foot* necessary (see foot-note 4):

Carbon filament lamp, about 3; gem incandescent, about 2.5; 100-watt tungsten "B" lamps, about 1; 300-watt tungsten "C" lamp, about 0.65; mercury vapor lamp, about 0.55; flame carbon arc lamp, about 0.55; and metallic flame arc lamp, about 0.76.

As an additional practical step suppose we consider the utilization efficiency as a variable, and then it becomes apparent that any specification which refers primarily to the light source is subject to large differences in the matter of the illumination which will be incident to the objects to be seen, unless all the factors just discussed and given due weight are taken into account.

Efforts to Formulate Better Rules

The Committee on Lighting Legislation of the Illuminating Engineering Society has made a study into the subject of factory lighting for several years past. About three years ago this committee felt that the time had come for the preparation of a set of rules or a code on factory lighting which could be used as a guide by industrial plants in the improvement of lighting conditions, or as a basis for adequate state lighting legislation as occasion might arise. At that time a new committee was appointed by the Society known as the Committee on Factory Lighting, on which the writer served as Chairman, the object being to draft out a Factory Lighting Code which could be adopted by the Legislative Committee and used for the purposes just mentioned.

The principal difference between the code which was prepared by this committee and previous rules lay in the specification of illumination intensities at the work rather than in terms of the quantity of light to be produced by the lamps. This was a marked step forward and involved much more than is apparent at first sight because of the difficulties in the way of accurate determination of intensity which were faced at that time. Moreover, the ideas of illumination intensity were vague in the minds of factory people and the specification of the illumination at the work as 1, 2 or 3 foot candles had little or no meaning.

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[1] The ratio of the light flux incident to the working surface to the total light flux generated by the lamps of the system expressed as a percentage.

[2] The foot-candle, as the common unit of illumination, is defined in the Code of Factory Lighting, I.E.S., as the lighting effect produced upon an object by a standard candle at a distance of one foot, this effect varying, in general, as an inverse function of the distance between lamp and object squared.

[3] The lumen is the name given to the unit of light flux. Thus a lamp may be rated in terms of the total lumens it produces.

[4] These particular values, as worked out by the writer, were discussed briefly in the *Electrical World*, June 23, 1917, p. 1204

Notwithstanding these difficulties, the Committee on Lighting Legislation adopted a code which included intensity specifications, and in 1915 this code was issued by the Illuminating Engineering Society as an official document. This original code contained 11 articles or rules which constituted the code proper. These were followed by eight explanatory notes or rules and about 40 pages of descriptive matter illustrating the principal features of good factory lighting. In its original form (next column) this code contained four divisions of factory work and all the intensity specifications related to these four divisions. One of the rules, i. e. the one on auxiliary or emergency lighting, was the object of some uncertainty from the beginning on the part of those who attempted to comply with the code under practical conditions. This relates to the question of installing auxiliary lamps in every factory section in addition to the regular lamps as a safety measure.

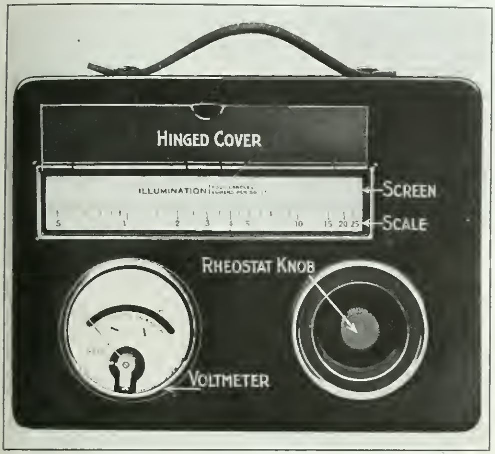

FIG. 1. FRONT VIEW OF THE NEW SHARP "FOOT-CANDLE" METER WITH A DESIGNATION OF THE VARIOUS PARTS

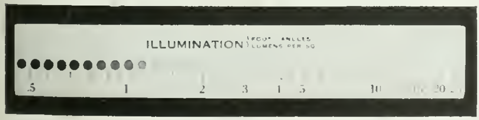

FIG. 2. AN ENLARGED VIEW OF THE SCREEN OF THE "FOOT-CANDLE" METER SHOWING THE CONDITIONS CORRESPONDING TO A READING OF 5.5 FOOT-CANDLES

REVISION OF THE I. E. S. CODE

An important revision of the original code of the Illuminating Engineering Society was made by its Committee on Lighting Legislation on June 26, 1917, in which the articles or rules have been practically re-written and the table of intensity specifications considerably amplified.

In the main, the original code has been shortened and the rules reduced from 11 to 6 in number. Furthermore the rules themselves have been made the subject of a most careful study as to the wording and the exact meaning which it is the desire of the Committe to convey. In its present form, this code is an improvement over the original code and it represents the result of opinions based on the experience with the original draft in several states and the comments by various authorities during the past two years since its first appearance.

The following paragraphs constitute the six articles of the Code as revised:

CODE OF LIGHTING FACTORIES, MILLS AND OTHER WORK PLACES

RULE 1.—GENERAL REQUIREMENT

Working or traversed spaces in buildings or grounds shall be supplied during the time of use, with artificial light in accordance with the following rules, when natural light is less than the intensities specified in Rule 2.

RULE 2.—INTENSITY REQUIRED

The desirable illumination to be provided and the minimum to be maintained are given in the following table:

	Foot-Candles* at the Work.		
	Ordinary Practice		Minimum
(a) Roadways and yard thoroughfares.	0.05	0.25	0.02
(b) Storage spaces	0.50	1.00	0.25
(c) Stairways, passageways, aisles......	0.75	2.00	0.25
(d) Rough manufacturing such as rough machining, rough assembling, rough bench work	2.00	4.00	1.25
(d) Rough manufacturing involving closer discrimination of detail.....	3.00	6.00	2.00
(f) Fine manufacturing such as fine lathe work, pattern and tool making, light colored textiles	4.00	8.00	3.00
(g) Special cases of fine work, such as watch making, engraving, drafting, dark colored textiles	10.00	15.00	5.00
(h) Office work such as accounting, typewriting, etc.	4.00	8.00	3.00

NOTE.—Measurements of illumination are to be made at the work with a properly standardized portable photometer.

RULE 3.—SHADING OF LAMPS

Lamps shall be suitably shaded to minimize glare.

NOTE.—Glare, either from lamps or from unduly bright reflecting surfaces, produces eye-strain and increases accident hazard.

RULE 4.—DISTRIBUTION OF LIGHT ON WORK

Lamps shall be so installed in regard to height, spacing, reflectors or other accessories, as to secure a good distribution of light on the work, avoiding objectionable shadows and sharp contrasts of intensity.

RULE 5.—EMERGENCY LIGHTING

Emergency lamps shall be provided in all work space, aisles, stairways, passageways and exits to provide for reliable operation when, through accident or other cause, the regular lighting is extinguished. Such lamps shall be in operation concurrently with the regular lighting and independent thereof.

RULE 6.—SWITCHING AND CONTROLLING APPARATUS

Switching or controlling apparatus shall be so placed that at least pilot or night lights may be turned on at the main points of entrance.

PENNSYLVANIA AND NEW JERSEY

Following the issuance of the I. E. S. code in 1915 the state industrial boards in Pennsylvania and New Jersey began active steps to draft out similar codes for adoption in legal form, with the result that on June 1, 1916, the Pennsylvania Department of Labor and Industry placed in operation a lighting code modeled after the I. E. S. code and in co-operation with the Committee on Lighting Legislation previously referred to. In like manner the Department of Labor of New Jersey placed in operation a code of Factory Lighting on August 1, 1916. No changes in either of these state codes have come to the writer's attention, although the indications point to a revision of each in line with the recent revisions of the I. E. S. code.

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*The foot-candle, the common unit of illumination, is the lighting effect produced upon an object by a standard candle at a distance of one foot; at two feet, the effect would be not one-half foot-candle, but one-fourth foot-candle, etc. A lamp which would give off 16 candlepower uniformly in all directions would produce a uniform illumination of one foot-candle at a distance of four feet in any direction.

Action in New York

As early as 1913 the New York State Factory Commission issued proposed revised regulations governing factory lighting entitled "Proposed Bill No. 18." All of the references to lighting in this bill were of a general nature, that is, no effort was made at that time to incorporate definite intensities of illumination at the work. However, the wording and substance of these clauses in reference to lighting were very carefully prepared with the co-operation of the Committee on Lighting Legislation of the I. E. S. and they constituted a step forward in 1913. In fact, this was one of the earliest cases where this Committee of the Illuminating Engineering Society worked in conjunction with a state factory board in the preparation of lighting rules. It has been reported (in October, 1917) that New York State has accepted the new I. E. S. code with additional classifications of work for possible use in its proposed state code.

Progress in Wisconsin

A notable example of progress in factory lighting legislation during 1917 is that of the new Handbook on Industrial Lighting issued August 1, 1917, by the Industrial Commission of Wisconsin. Earlier in this article reference was made to the first efforts made in Wisconsin to prepare more specific lighting rules in 1913. The defects in these earlier rules were pointed out, and it is a matter of unusual interest to note that the new Wisconsin rules in proposed form completely abandon the candle-power specification and have adopted a specification of intensity of the work with the coöperation and active help of the I. E. S. Committee on Lighting Legislation. This new Handbook consists of 91 pages and is a well prepared statement of the factory lighting problem, much of the credit for which is due to Mr. John A. Hoeveler, the Illuminating Engineer of the Industrial Commission, and to Mr. F. A. Vaughn, who represented the I. E. S. during the work of preparing the new rules. Table on page 119 indicates the intensity values in these proposed new rules.

Proposed Code for Ohio

During 1917 a committee, under the direction of the Ohio Industrial Commission, prepared a new Code on Factory Lighting as one of a series of codes dealing with factory safety which that commission is now considering. At present this code is in preliminary form and is subject to public hearing and final revision. By courtesy of Mr. V. T. Noonan, Director of Safety of the Industrial Commission, the following comments are included concerning this new proposed Ohio code.

The proposed rules are four in number, covering (a) general requirements; (b) intensities required; (c) glare; and (d) distribution of light on the work. A marked departure from the strict wording of the I. E. S. code as given above is the unusually well worked out classification of industries. Thus the intensity specifications are placed under six main headings as follows: (a) Roadways and yard thoroughfares; (b) intermediate and auxiliary spaces in interiors; (c) rough operations; (d) medium operations; (e) fine operations; and (f) special cases. This results in five principal grades of work on the basis of which nearly 50 industries are subject to a further classification. For example, paper manufacturing is sub-divided into (1) beaters; (2) calendering; (3) machine; (4) grinding; and (5) finishing, cutting and trimming. Each of these five subdivisions is assigned to one of the principal grades given above.

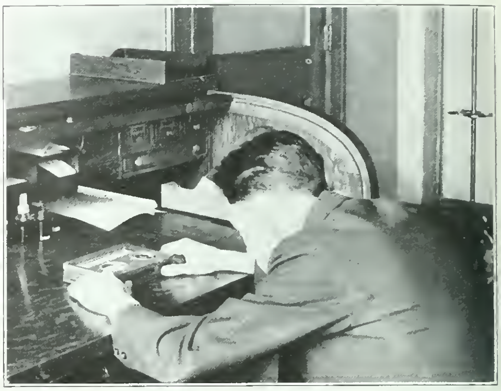


FIG. 3. SHOWING THE USE OF THE "FOOT-CANDLE" METER FOR MEASURING THE ILLUMINATION OF A DESK SURFACE

An appendix to the proposed Ohio code contains a discussion of light units; on the character of illumination, which includes glare, diffusion and color; daylight; accident prevention; economical considerations; maintenance; and other important

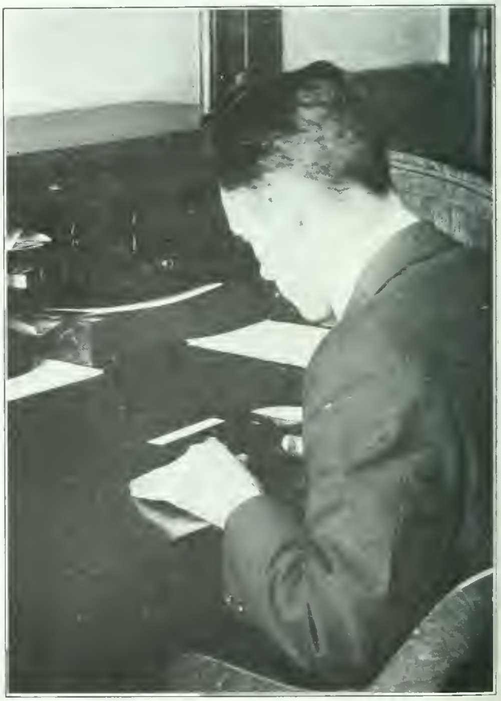


FIG. 4. USE OF THE "FOOT-CANDLE" METER FOR THE SAME PURPOSE AS IN FIG. 3. EXCEPT THAT THE OPERATOR HERE ASSUMES THE NORMAL WORKING POSITION OF THE OCCUPANT OF THE DESK

points. It is interesting to note the personnel of the committee which has been responsible for this Ohio code. Prof. F. C. Caldwell of Ohio State University headed the committee, which was made up of the following members: H. H. Craiglow, Buckeye Steel Castings Co.; S. E. Doane, Chief Engineer, National Lamp Works; Thos. J. Donnelley, Secretary, Ohio Federation of Labor; J. J. Graney of the same organization; H. L. Jenkins, Holophane Glass Works, and Geo. W. Walker, Cooper Hewitt Electric Co.

Code Requirements Which Are Still Uncertain

While the specification of illumination intensity has itself been reduced to a fairly definite basis, there are a number of points in the revised I. E. S. Code which are still more or less indefinite, and concerning which it is to be hoped that a more positive statement of the rules will be decided upon in the near future. Perhaps the most important items of this kind are those which relate to glare and to the distribution of light. *To avoid glare* and *to produce a good distribution of light* are both requirements which are indefinite and difficult to enforce without more specific information.

Efforts have been made by the authorities of the Wisconsin Commission to draft out more definite rules for these two items of glare and distribution but up to the end of October, 1917, the Committee on Lighting Legislation has not considered it advisable to make any such changes. A sub-committee has, however, been appointed to take up these points more in detail.

At present, opinions differ somewhat as to what specifications should cover glare and distribution. The tendency seems to be towards a requirement of a minimum candle-power per square inch of light source as the specification for glare, and the suggestion has been made to specify a ratio of maximum to minimum intensity over a working surface in the matter of distribution. Subsequent work along these lines will likely result in more satisfactory rules.

Checking Intensity by Measurement

One of the most serious difficulties in the way of enforcing or living up to specifications of illumination intensity as outlined in these new codes, has been the lack of suitable measuring instruments which were sufficiently inexpensive and which required no particular degree of skill to operate. While more expensive and elaborate instruments have been available for a number of years they have been so costly that there was no likelihood that the average industrial plant, or even the average factory inspector, would be provided with such devices for the practical checking up of illumination values.

It is of unusual interest, therefore, that during 1917 a new and simplified instrument has been placed on the market known as the "Foot-Candle Meter" with which a fairly close measurement may be made of the intensity at the work. Figure 1 shows the elements of such an instrument; Figure 2 shows the disk indicating an intensity of 5.5 foot-candles, while Figures 3 and 4 show respectively how a measurement may be made (a) of the actual illumination from overhead lamps on a desk surface and (b) of the net illumination received on a desk surface from overhead lamps when the occupant of the desk is in the normal working position.

It is believed that no single development in the industrial lighting field promises so much in reducing lighting legislation to a definite basis as such an instrument, which requires practicaly no more skill in its operation than that in reading a thermometer. With the more general use of such apparatus in the industries, the difficulties previously faced in the use of an intensity specification are considerably lessened and the whole problem is reduced to a more satisfactory basis.

These notes show the trend in matters of lighting legislation at this time and point to the methods which are being followed to make such rules definitely applicable to industrial conditions. For those readers who may desire to follow up these developments more closely, there can perhaps be no better step than to secure copies of the complete codes which have been mentioned, the contents of which will be found to include a considerable amount of useful material both on the legislative side of the question as well as on its practical working aspects.

Activities of the Engineering Societies In War Work

The American Institute of Electrical Engineers, has assisted the government in obtaining the services of technical men for the following branches of service: By request of the Bureau of Navigation the Institute nominated eighty-five graduate electrical engineers for appointment as lieutenants, junior grade, United States Naval Reserve Force; Bureau of Yards and Docks, candidates for appointment in the Civil Engineer Corps of the United States Naval Reserve Force, for the ranks of ensign, lieutenant, junior grade, and lieutenant; Bureau of Chemistry, electrical and mechanical engineers for special investigations throughout the country; Signal Corps, electrical men for the radio division and the aviation section; Bureau of Navigation, candidates for aviation inspection duty for training as ensigns in the Naval Reserve Flying Corps; Coast Artillery School, department of enlisted specialists, draftsmen, engineers, electricians and radio operators, as temporary non-commissioned officers, and in many other ways.

The American Society of Mechanical Engineers has done similar service in furnishing men in lots from one to a hundred or so for government and civilian service. It has assisted materially in the fuel administration through coöperation with the officers of the Bureau of Mines.

The Illuminating Engineering Society has had a similar experience and through its committee on war service has been able to be of considerable very evident service to the government in the design of lighting for buildings and grounds of aviation camps and for night flying, and also in the design of lighting for other buildings being erected by the Navy Department and the Department of War. This society at the request of Samuel Gompers nominated two members to serve with the committee of labor of the Council of National Defense to take up the question of factory, mill and workshop lighting, (1) to conserve eyesight of workmen, (2) to make factories safe by proper lighting, (3) by giving proper lighting to increase efficiency of workmen, and (4) to increase output and decrease spoilage. A code on lighting was prepared by the members designated by the society and accepted by the government. It has not yet been distributed, owing to the pressure of other work. Five states already have taken up the rules of the code and have either put them into practice or are under way to do so.—*Electrical World, N. Y.*: January 5, 1918.

How to Locate Machine Tools

Production Costs May Be Cut by Planning the Arrangement of Machines and Working Spaces

By Gustav H. Radebaugh

The scheme of manufacturing, choice of types of machines for various operations, routing output, and despatching work in process, all of these factors influence the location and arrangement of machines in an industrial plant. The author's method of determining machine location involves the use of wooden templets and a skeleton of the factory floor area, both on a reduced scale. The article also shows forms for the control of production.

Mr. Gustav H. Radebaugh *served an apprenticeship as instrument and die-maker, became a contractor and builder of dynamometer car recording instruments and, in 1915, was consulting construction engineer for the Imperial Government Railway of Japan. Later he was engaged in factory orgfanization and production work in several industrial plants in the middle west. At present he is an associate in factory management and machine-shop practice, and acting director of the various shop laboratories at the University of Illinois at Urbana.*

In arranging machines to facilitate effective shop operation, it is obvious that the style of product to be manufactured constitutes the base on which to work. A mistake is frequently made in arranging the general plan of the shop, such as locating tool storage rooms, work benches, assembly benches, material rooms, machines, etc., before the manufacturing method has been determined upon. If this style of procedure is followed, inefficiencies are sure to exist. If no definite path of travel of the product has been fixed upon, there is loss in transportation and a greater amount of money than necessary tied up in stock to permit the volume of output to be obtained.

PLANNING PRODUCTION

The first step to take, is the analysis of the product, outlining exhaustively the production sequence of manufacture. This can be accomplished (1) by making a stock list of the parts of the machine to be manufactured, assigning to each part a stock number; (2) by determining the methods of machining each part; (3) establishing the output of the factory; (4) determining the kinds of machines to be used, and (5) the number of machines required; (6) outlining assembly operations and plan of assembly; (7) locating machines in relation to routing the product through the shop, the size of parts to be considered in doing the same; (8) locating stock and supply storage rooms, and unit assembly benches; (9) determining storage spaces for material; (10) establishing inspection methods and stations; (11) trucking and (12) transportation method employed, hand trucks, cranes, telepher or motor trucking.

LOCATING MACHINES

In making the choice of types of machines to be used in machining parts, it must be recognized that several important items govern the choice, such as (1) quantities to be machined; (2) general method of performing operation (air or plane chuck, centers, jig or fixtures, etc.); (3) kind of material being machined and amount to be removed; (4) what kind of finish; (5) can the operation be performed conveniently; (6) production guaranteed by builder, etc.

When the machines have been decided upon, an operation routing card may be made out for each part being machined. This shows the sequence of operations performed on the part and gives the necessary information for locating the machines in the shop so that trucking confusion may be reduced to a minimum. Machines are arranged according to one of the following three classifications shown herewith:

A. Concentration of product.
B. Concentration of machines.
C. Jobbing or contract plan.

It must be understood that the style of product governs the style of machine arrangement. For instance, a one- or two-product shop has its machines arranged under plan A. If several articles are manufactured and special work is going through the shop, plan B would, most likely, prove the best. The choice of plan for machine arrangement takes into consideration the routing of the product, its size, fire risks, assembly of product, and methods of department transportation.

To make practicable the proper location of machines, especially in the factories involving a large volume of manufacturing, has been a difficult problem, but large manufacturers have very generally appreciated the profit significance of the location of machines in relation to the routing of the product. This has encouraged the development of several plans for assisting the engineer to solve his problems of this nature.

The machine arrangement board, Figure 1, has made it possible to locate machines much more accurately than by the use of the drawing board. Small blocks of wood are cut showing the outline of the machines, unit assembly benches, inspection stands, and material storage spaces, these blocks being to scale. It is good practice to print on the block the name of what it represents. Model machines should have size, horse power and floor space required, and other information entered as shown in Figure 2. Two holes are drilled through the blocks permitting the double use of glass pushpins for holding the block in place and the running through of threads of various colors which help to indicate the route traveled by a part. These colored threads in the graphic plan show clearly the tracing and retracing of the product through the shop. As shown in the figure, the machines are arranged on the *boards* which *represent* the exact outline and size of the first and second floors of the factory, being made to scale.

By the use of this graphical plan of locating machines, a scientific analysis can be made which shows up clearly all back tracing of parts. To get the greatest benefit, this analysis can be used in the design of the plant, placing information, when possible, in the hands of the architect in order to eliminate botched up factory design. It is also a useful agent in determining the location of unit assembly benches, delivery chutes, tool storage, superintendent's office, stairways, windows, delivery doors, cranes, and inspection stands. This machine arrangement board will be, if used in a plant where the product is changing in yearly cycles or *when* development work is going on, a convenient and useful equipment for the engineering department, as it permits setups so that the routing of new parts may be studied. Reliable information is always on hand in regard to *department* arrangements if a graphical plan of this kind is maintained.

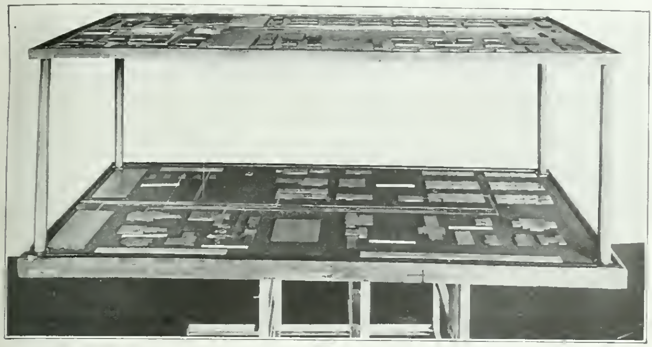


FIG. I. MACHINE ARRANGEMENT BOARD. AN ACCURATE AND CONVENIENT MEANS OF VISUALIZING THE ARRANGEMENT OF MACHINES

Graphical method employed to analyze machine location. Tracing and retracing of the products are determined by use of colored threads. A factory floor model in the engineering department makes possible more effective control of machines

Machine Control

It is helpful to number all machines. It has also been found an aid to showing location and to a complete understanding of the routing of the product, to have all departments designated by some symbol, this symbol being prefixed to the machine number. Different types of machine tools may be given range of numbers, such as the lathe group 1—500, planer group 500—600, etc. A lathe located in department A and being the twentieth lathe purchased, is designated A_{20}. This number may be painted on the machine in white or yellow. A good coat of *clear* shellac should be applied to preserve the numbers in their original distinctness. Aluminum numbers, such as those used to number houses, also serve this purpose well, as they stand the usual factory abuse and, being 2½ inches high, are easy to see.

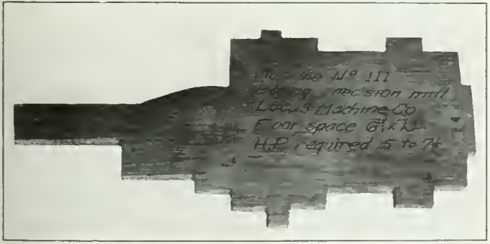


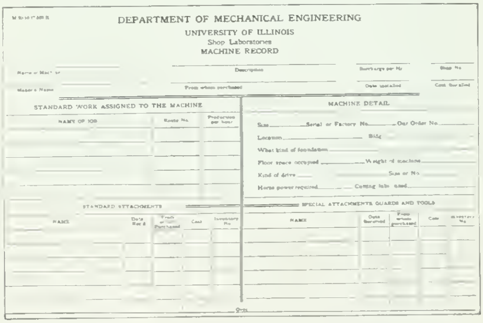
FIG. 2. BORING MACHINE MODEL

This shows a sample block representing a machine as used on the machine arrangement board. These blocks may be made up to represent assembly benches, inspection stands, material storage, etc.

To make a complete office record of the machines a card as shown in Figure 3, records information valuable in determining the planning of jobs for machining operation. This record also furnishes a complete inventory of machine attachments, etc., and is of cash value when adjusting a claim of fire loss. The cards are filed according to department and type of machine. This permanent record also incorporates the location, changes of location with dates of change, weight, method of drive, horse power required, floor space required, price paid for special attachments, and repairs made including their cost. The advantage of using a card record for each individual machine is readily appreciated if all the information is given as listed. The engineering or planning department of a plant can certainly control the planning of machine operations much more effectively if this information is at command. It is of further value in deciding on the purchase of a new machine. The breakage record may be consulted and weak places in design may be pointed out to the machine-tool builder, which information will be appreciated.

Routing Through the Shop

From the graphical method employed to determine the machine location, department routing sheets may be made for each part to be machined, and placed in the hands of the department foreman and truckers. By using the routing sheet as shown in Figure 4, the exact delivery of the material is established and also the machines used on the various operations are shown. The thinking has all been done and the foreman is relieved of the responsibility of replanning a job every time it goes through his department. The routing sequence has been recorded in such a form that it is convenient shop information. Too many times good records are not used because of the perplexing methods necessarily employed to handle them. The truckers are better informed as to where the stock should be delivered. If it is possible to include information as to the very best place for piling stock beside the machine, production will be increased, for it will not require so much of the operator's time to reach for his stock.



DEPARTMENT OF MECHANICAL ENGINEERING
UNIVERSITY OF ILLINOIS
Shop Laboratories
MACHINE RECORD

Name of Machine ____ Description ____ Surcharge per Hr ____ Shop No. ____
Maker's Name ____ From whom purchased ____ Date installed ____ Cost Installed ____

STANDARD WORK ASSIGNED TO THE MACHINE

NAME OF JOB	Route No.	Production per hour

MACHINE DETAIL

Size ____ Serial or Factory No. ____ Our Order No. ____
Location ____ Bldg. ____
What kind of foundation ____
Floor space occupied ____ Weight of machine ____
Kind of drive ____ Size or No. ____
Horse power required ____ Coming into used ____

STANDARD ATTACHMENTS

NAME	Date Rec'd	From whom Purchased	Cost	Inventory No.

SPECIAL ATTACHMENTS GUARDS AND TOOLS

NAME	Date Received	From whom purchased	Cost	Inventory No.

Over

FIG. 3. FORM FOR RECORD OF MACHINES

This card 5½" x 8½" is kept in a card file

Dispatching Work

After the route has been decided, methods for dispatching the product through the shop to the best advantage must be determined. To centralize the control of the plant by placing all the record control in one office, makes it possible to adjust the output so as to insure an even flow of the product through the shop to the assembly department. This eliminates, to a certain degree, the confusion so often visible in the assembly department on account of the shortage of parts.

Consider now the effect of a dispatching plan in a shop. The parts of the product are more evenly distributed about the shop, the lots are arranged in size according to the amounts necessary to perform the operation as cheaply as possible. Some one about the plant is responsible for each part of the product being machined. By dispatching, you eliminate a shop confusion that cuts into production. Most of the time loss in shops that do not use dispatching plans, is the outcome of one or more of the following conditions: looking up of material, lost and spoiled material, not arranging material in correct lots which causes difficulties in accounting by delivering of part lots, delay of assembly on account of shortage of parts, and failure to deliver material to proper machine.

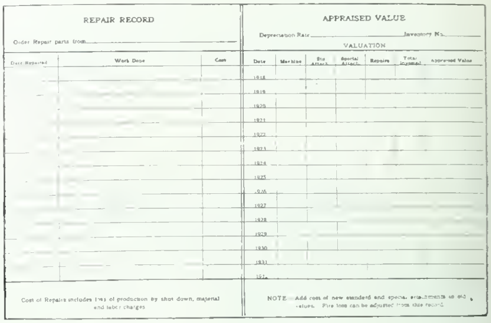
Dispatching of work is not a complicated, *unreasonable* operation. Routing precedes dispatching. In routing the product, you decide and establish the path of travel of the part from the time it is received as raw material until, after going from machine to machine, it is turned out a finished product. In dispatching the product, the operation is to control its delivery from machine to machine in such manner as to obviate delay in the completion of the job. Time being established on every job, it is possible for a dispatcher to know just how long lots of material should stay at a machine. If he has proper methods of control the solution of his problem becomes quite simple and extremely effective. Dispatching of materials in a factory is equivalent to train dispatching. Since dispatching, if it does not make possible more effective control of production in the plant thus resulting in an increased profit return, is worthless, a plan of dispatching of extreme simplicity should be adopted. It should take all clerical work away from the mechanic and should not use too many printed forms.

The plan of dispatching work, shown in Figure 5, is that in use in the machine shop of the University of Illinois. By controlling the work at the machines from a central dispatching office so that the operator may keep his machine producing all the time instead of spending time in going about the plant looking for stock, instructions for the work, tools, inspectors, and truckers, this particular dispatching plan has realized an increase in output. A work order card is issued to the workman, this card bearing with it instructions as to number of job, operation number, lot number, machine to use and standard time allowed on job. The material, tools, jigs, fixtures and instruction card are issued from the tool storage and material rooms by order of the dispatching clerk to the machine where the job is to be performed, the delivery being made before the operator is ready to start on the job, with the object of eliminating loss of time on the part of the operator.

These essential dispatching problems are in part controlled by the production dispatch calendar and the work distribution board. In Figure 6 a general view is shown. They are the same size, 4 feet wide by 76 inches high and are made from wood. They are located in the dispatching office and are placed so that they can be seen easily from the job assigning window. This office is located centrally in the shop which makes it convenient for the assignment of work.

The work distribution board gives to the clerk assigning jobs, information as to what machines are in use. Its greatest benefit is in solving problems of assigning machines when two or more shifts are employed.

Referring to Figure 7, a closer view, it can be seen that four shifts can be recorded, the record here given shows that two men are working on machine No. 1 which is a lathe. The cards that the entries are made on are white and red. Red indicates chuck or special setups, white indicates center work. The machine operator's name and his shop number, job and job number appears on these cards. When the job is assigned to a machine entries are made on these cards, the card is then placed in the holder as shown. The shifts are represented by P, Q, L, and N.



REPAIR RECORD

Order Repair parts from____________

Date Repaired	Work Done	Cost

Cost of Repairs includes loss of production by shut down, material and labor charges

APPRAISED VALUE

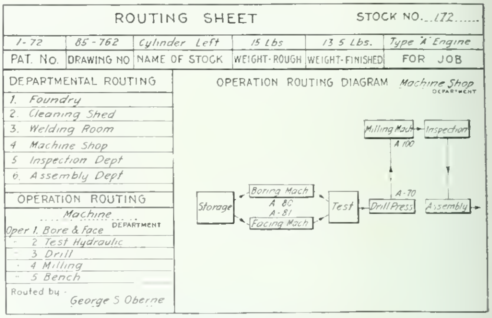
Depreciation Rate__________ Inventory No.________

VALUATION

Date	Machine	Std Attach.	Special Attach.	Repairs	Total increase	Appraised Value
1918						
1919						
1920						
1921						
1922						
1923						
1924						
1925						
1926						
1927						
1928						
1929						
1930						
1931						
191_						

NOTE — Add cost of new standard and special attachments to old values. Fire loss can be adjusted from this record.

FIG. 3-A. REVERSE OF CARD SHOWN BY FIG. 3



ROUTING SHEET STOCK NO. 172

PAT. No.	DRAWING NO	NAME OF STOCK	WEIGHT-ROUGH	WEIGHT-FINISHED	FOR JOB
1-72	85-762	Cylinder Left	15 Lbs	13 5 Lbs.	Type "A" Engine

DEPARTMENTAL ROUTING

1. Foundry
2. Cleaning Shed
3. Welding Room
4 Machine Shop
5 Inspection Dept
6. Assembly Dept

OPERATION ROUTING

Machine DEPARTMENT

Oper 1. Bore & Face
" 2 Test Hydraulic
" 3 Drill
" 4 Milling
" 5 Bench

Routed by - George S Oberne

FIG. 4. SPECIMEN ROUTING SHEET

A routing sheet in the hands of the foreman and truckers helps them to care for a larger volume of jobs. Planning has been done and path of travel established, so it is not necessary to replan a job every time it comes into the shop

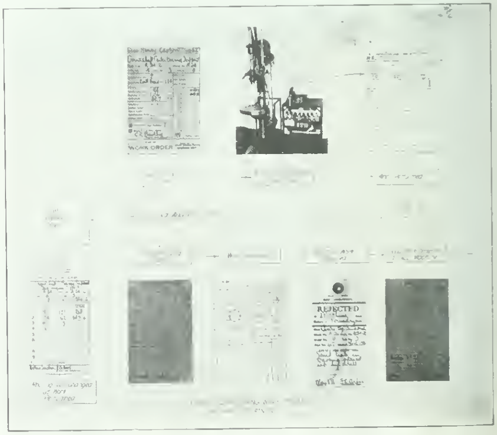


FIG. 5. THE DISPATCHING PLAN

The graphic lay-out of forms shows clearly the dispatching plan of the Machine Shop, University of Illinois. This plan relieves a workman of all clerical work and of the responsibility of getting material and tools to his machines

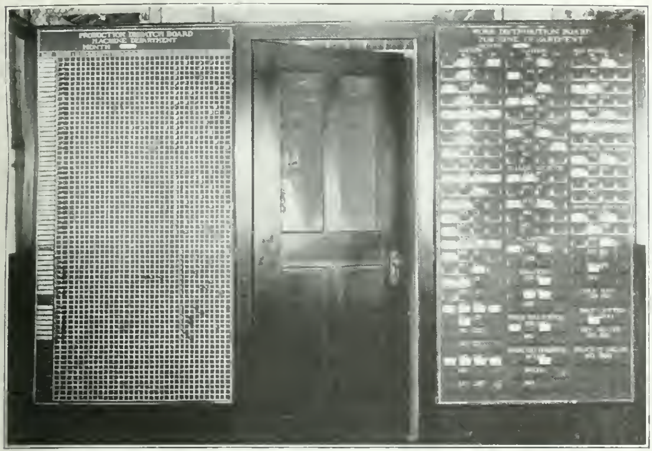


FIG. 6. PRODUCTION DISPATCH CALENDAR AND WORK DISTRIBUTION BOARD

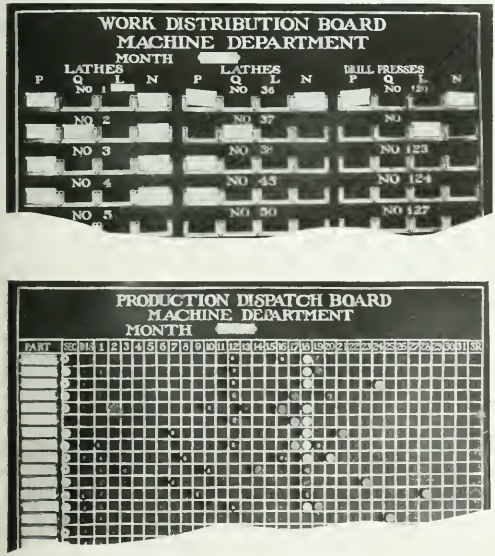


FIG. 7. A CLOSER VIEW OF THE WORK DISTRIBUTION BOARD AND PRODUCTION DISPATCH CALENDAR

The simple methods employed here, encourage its use for controlling dispatching activities in the shop

On the production dispatch calendar job entries are made, the information being secured from a manufacturing schedule which has been established by trade demands.

All work assigned to the shop is dispatched from this calendar. Using this plan a graphical record is made showing the progress of the work in the shop.

Greater output can be encouraged by a calendar of work which shows up clearly shop information such as progress of the work by days, etc. The worker realizes that his activities are recorded, that the management knows just what he is doing each day. We all work better when a standard task is set up for us, the time limits being given and the knowledge that the management knows just what we are doing.

In the closer view, Figure 7, a job entry is shown. The card in the holder to the left of the view gives name and number of job and route number. The value of the plugs reading to the right is as follows. On the first file, Plug *P* represents the shift, Plug *1* is the operation number, Plug *S* shows that the job was started on October 12, the *R* plug indicates that on the October 16 it was known that the operator was falling behind schedule, on October 18, lathe 5 was being used, the *F* plug shows at what date the job should be completed. You will also notice plugs with the letter *I* which indicates work is being inspected, *C* which indicates job has been completed, *B8* shows bench location.

When a dispatcher becomes acquainted with the meanings of these symbols which can be reduced to the very smallest number, conditions of an order can be reviewed at a glance. The delivery requirement of the assembly department can be met with more promptness and with much less exertion when some control is incorporated in the management of the shop that gives a graphical picture of work progress.

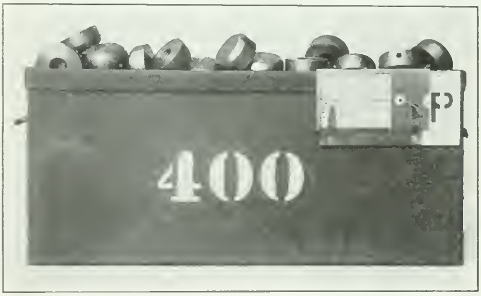


FIG. 8. TOTE BOX WITH INSPECTION AND MOVE CARD

In this view is seen the Inspection and move card in position on a tote box of materials. The card is in the window envelope which is used to protect the record from shop abuse. The card holder is not fixed to the tote box

A shop routing card (Figure 5) is used to establish a record of each lot started. The machine number, the man number and date of delivery to next machine is recorded. This card is kept in a drawer having pocket numbers for each machine in the shop. If machine No. B_5 on Route 4 is being used, this card is placed in pocket, machine No. B_5. The dispatcher can control all the route cards from this drawer as the machine classification permits easy access to the individual route cards. The inspect and move card is always kept with the material as shown in Figure 8, in order to identify the material in the shop. If the inspect side of the card is out, this is to notify the inspector that the work is ready for his attention; if the move side is out, it is to notify the trucker that the material is ready to be moved. All records of inspection and trucking are on this card. As shown in the view, the card is held on the tote box by a holder which is hooked over the edge of the box and the card is placed in a window envelope held by spring clips. The envelope is used to keep the card clean, insuring the legibility of the record.

Training Engineers and Firemen

How Wisconsin is Helping the Men in the Power Plants Under State Control to Do Better Work

By Allen W. Ruggles

Two state departments of Wisconsin have been coöperating for the past two years in providing practical training and education for the employees of twenty-seven power plants in state buildings and institutions. The results are encouraging, particularly in the development of the spirit of coöperation. The plan might profitably be adopted by other states, particularly in these days of fuel shortage.

Mr. Allen M. Ruggles *after completing his education at the universities of Wisconsin and Columbia taught for six years, and in* 1914 *became efficiency examiner and director of educational work for the Wisconsin Civil Service Commission. In that position he has been instrumental in assisting the development of the educational plan described in the article presented herewith.*

THE engineering department and the civil service commission of the state of Wisconsin are thoroughly agreed that "the main part of scientific employment begins after the act of hiring is completed." For two years these two departments of the state government have been working on the development of a practical application of this idea as it affects the employees of the twenty-seven power plants under state control.

In this movement of training and education three factors have played an important part:

1. The annual school for power-plant engineers.
2. The university extension "service courses."
3. The development of the proper spirit of coöperation within the service.

The activities along these three lines are making a real contribution to the efficiency of state power-plant operation. The third of these may seem intangible and yet it may be truly said that in the minds of the engineers of the Wisconsin state service this factor stands out just as clearly as do either of the others mentioned above. It is the factor that is giving life to the other two activities.

In connection with this educational movement the departments concerned are also coöperating in working out a fair and orderly scheme of promotions, reasonable hours and just salaries.

Annual School for Engineers

The annual school of power-plant engineers held by the Wisconsin Civil Service Commission and the Department of Engineering has in the two years of its life shown itself to be of such value to the service that it is now looked upon as a fixed institution. The sessions of the school are held at Madison where there are two engineering plants under state control: the capitol power plant and the central heating plant of the university. The school is held in the summer when the work is lightest for the engineers and when they can most easily leave their plants. The meetings take place in the capitol building. The state pays the expense of the chief engineer from each institution under state control, and the boards and departments concerned feel that it is a profitable investment. The sessions continue for three days. There is a roll call at the opening of each session. Everything is conducted in a business-like way. Interest and earnestness are felt from first to last. It is an educational feast of give and take.

The program this year included the following topics:

Address of Welcome by the Governor.
Coöperation in the Service of the State.
Some Principles of Safety and Fire Protection.
What Engineers Have Done in Extension Courses.
Some of the State Power Plants (illustrated).
Heating and Ventilation.
Illumination and Safety (illustrated).
What the School Stands For.
Demonstration of Coal Sampling and Analysis.
Demonstration of Fire Pumps.
The Engineer in Public Service.
Duty of Engineers to the Board.
A New Conception of Public Duty.

STATE POWER PLANT ENGINEERS SAMPLING COAL AT THE SCHOOL FOR ENGINEERS

Engineers and Inspectors Cooperate

Some of the liveliest discussions of the school were started by talks given by the inspectors and representatives of other departments. As a result of these discussions and of the sympathetic understanding developed, the engineers and inspectors are now working with greater unity of purpose than ever before.

The plumbing inspector gave the men an entirely new idea of the value of proper plumbing, of the care of a plumbing system and of the best action in case of emergency.

The building inspector opened up a new field to the men. As one engineer said in his report to his superintendent: "Mr. Williams brought out as good points on fire protection as I ever heard. He spoke of dangers from fires and their remedies that I had never heard of before."

Concrete examples marked every discussion.

"At our institution there is a paper chute that seems to me to be the worst kind of a fire hazard——," began one of the engineers.

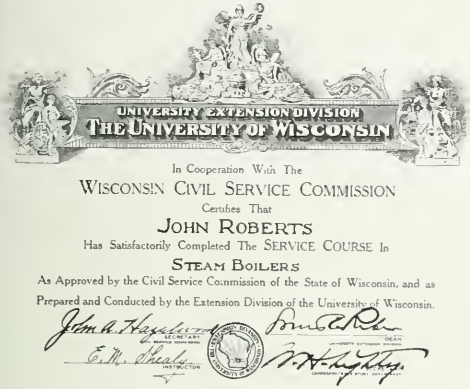
"Yes," said the inspector, "I saw that at my last visit and have ordered it remedied."

Soon the chief engineer entered into the discussion and promised to see that the matter was pushed for speedy attention. In this fashion the discussion went on, with added zest, from one concrete case to another.

The safety-first man from the industrial commission took the men to the capitol power plant and from actual examples pointed out to them the value of safety-first appliances, guards, etc.

The fire prevention inspector from the insurance commission was present at the meetings and talked with the men at every opportunity, with the result that he is now planning better fire brigades at the institutions.

The engineers showed an interest in the welfare of their institutions that would be a revelation to many who are not familiar with the actual attitude of these men. They see things that the superintendent is not trained to see, and as anyone familiar with the situation knows, their responsibility is not light.



UNIVERSITY EXTENSION DIVISION
THE UNIVERSITY OF WISCONSIN

In Cooperation With The
WISCONSIN CIVIL SERVICE COMMISSION
Certifies That
JOHN ROBERTS
Has Satisfactorily Completed The SERVICE COURSE In
STEAM BOILERS
As Approved by the Civil Service Commission of the State of Wisconsin, and as
Prepared and Conducted by the Extension Division of the University of Wisconsin.

John A. Hazelwood
SECRETARY

DEAN

E. M. Shealy
INSTRUCTOR

JOINT CERTIFICATE GIVEN BY CIVIL SERVICE COMMISSION AND THE UNIVERSITY EXTENSION DIVISION

COAL SAMPLING AND ANALYSIS

As was natural, one of the subjects of most vital interest was that of coal, and the fact that the state buys its coal on the heat unit basis served to center this interest on its sampling and analysis.

The chemist of the capitol power plant demonstrated the method of sampling coal, using a new sampler, a number of which have been ordered for use in the state institutions. The engineers must secure samples from each car of coal received and send them to Madison for analysis. It was impressed upon them that they must know how to get a *fair* sample, that they must know how to crush it, quarter and requarter it and prepare it for shipment. Very detailed instructions were given as to the process.

Not only did the men receive instruction on sampling, but they were taken to the laboratories where the chemist explained to them in full, with demonstration, the process used in the analysis of coal that is sent in from the institutions. This gave the engineers a clearer idea of their part in the process as a whole, increased their interest and brought home to them with added force the fact that a successful analysis depends upon a fair and careful sampling. The engineering department believes that letting an employee in on the problems of his coworkers and of those above him in authority leads to growth and stimulates coöperation.

SPIRIT BACK OF THE MOVEMENT

As suggested in the beginning, the spirit which pervades this school is a vital factor in the movement of which the school is a part. It is one of the really interesting and suggestive features of the movement. Wisconsin is especially fortunate in that its chief state engineer, Mr. J. G. D. Mack, and its power plant engineer, Mr. J. C. White, are personifications of those qualities that inspire efficiency in public service; men whose watchword is coöperation, and who in all things stand for a democracy of public service in which the humblest employee is looked to for suggestions and given due credit and encouragement. The spirit of these men has been felt in every session of the school. As one of the engineers told his superintendent: "Coöperation is Mr. Mack's 'pet hobby' and it is certainly evident that he is getting results."

These two men reiterated the idea of coöperation and the democracy of public service time and time again.

> Selfishness and narrowness dominate the engineer who tries to bottle up within himself all the things worth-knowing or good about the plant and does not give credit to the help he has. Develop each one of your assistants as far as he can go. The competence and loyalty of the crew you have under you is a measure of your success.
>
> In this matter of coöperation, one of the principal things is the giving of proper credit to the subordinate who does things and who really is entitled to it. Without coöperation we cannot make a success of this great business enterprise of the state of Wisconsin. Team work and honest coöperation is the policy of this department.

ATTITUDE OF THE ENGINEERS

The interest of the engineers, their questions and conversation showed beyond a doubt the value of the school. They showed real enthusiasm. They have "caught the spirit of the hive." There is a splendid *esprit de corps.* The following extracts from reports made by the men to their superintendents give their point of view.

> The mingling of the engineers, talking over the work done in their respective institutions was very helpful. I heard that a certain gas producer was a failure in economy. On the other hand, I gave information to several on an effective boiler compound that we have in use here.
>
> I appreciate the efforts of the men who took part on the program and their desire to help us. They made us feel that we are a necessary part of the state service and that it is up to us to equip ourselves with the knowledge necessary to perform our duty in the best possible manner.

It is planned to have the engineers take a greater part on the program next year. This last year, however, each meeting was presided over by a power plant engineer.

SERVICE COURSES

As a result of last year's school and of the need felt for keeping up the good work started and of carrying through the year the same spirit of progress, the university extension division was asked to coöperate in arranging a special course of study for state power plant engineers and firemen. The matter was given very careful attention by the civil service commission, the engineering department and the extension division. Professor E. M. Shealey represented the extension division at the conferences held and proposed the course of study which follows. The individual courses are known as "service courses" because they have been approved by the civil service commission and the engineering department. Those who finish them have a special record made of the fact on the books of the civil service commission, and in case of promotional examinations, credit is given for the work thus done. A special certificate issued jointly by the civil service commission and the extension division is also given on completion of a "service course."

This course of study begins at the bottom, is progressive and gets somewhere in the end. In other words, it has a definite plan that gives a well-rounded treatment of the problems of power-plant operation. In a much condensed form it follows the same scheme that is found in a regular course in a technical school. It also provides for all grades of ability, is flexible and makes it possible for an engineer or fireman to enter at any point at which he has the ability and experience to begin. The individual courses comprising the complete course of study follow:

Course 1. Practical hand firing. This course written in the simplest possible language is intensely practical and teaches the manual operations of firing without references to any theory of combustion or any calculations. It shows how to obtain the very best results in efficiency and smoke prevention with hand-fired boilers burning soft coal.

Course 2. Steam boilers. The course in boilers deals with the selection installation, management and testing of boilers.

Course 3. Heat. The course in heat is planned particularly to teach the applications of heat energy to the uses of man in power production and in industrial processes. The theories of heat are brought out in very simple form and their practical application shown.

Course 4. Steam engines. This is a practical course for operating engineers and to this end it deals with the operation of practically all classes of modern engines. It treats fully of both theory and practice as applied to steam engines but most largely with stationary engines.

ENCOURAGING SUPPORT

The idea of these "service courses" met with the approval of the heads of the institutions concerned. The response was encouraging as the following extracts from letters from superintendents of state institutions and presidents of normal schools will show:

> I have your note calling my attention to the course arranged for engineers and firemen in the state service. This is decidedly a step in advance and I am sure that greater and better service will be rendered the state because of this scheme of education.
>
> I thoroughly approve of all our men acquiring a theoretical as well as a working knowledge of their duties, and have intimated plainly to them through the chief engineer, that in advancing their places we shall give preference to those who show an ambition to advance in their work, and are willing to study toward that end.

REAL COÖPERATION

The chief engineers of the institutions have coöperated in a most encouraging fashion in interesting their men in the work. A letter was sent to each chief engineer, putting up to him the responsibility for the success of the work in his institution. As a result forty-one engineers and firemen registered in one or another of these courses. Professor Shealey declares that during his experience in extension work he has never had such a uniformly high grade of work done by any class of employees.

At the last annual school, the chief engineers had much to say of the extension courses and were greatly interested in the prospects for the coming year. One engineer told how he had helped his assistants. He had gone at it in regular school-master fashion using a blackboard in his explanations. When the men's interest or ambition lagged he encouraged them and kept things going.

At the capitol power plant there is a service club that meets every two weeks the year around. Most of the talks given at the meetings are illustrated by lantern slides, made by the chief engineer. This adds greatly to the interest. The talks concern in general the problems which the men meet in their everyday work and to which they have given considerable thought. In this way they become familiar with each other's work and investigations and the interest of all is broadened.

Some time ago the efficiency division of the civil service commission issued a circular letter on the work of this club and sent it to the other engineers and firemen in the state service. The idea proved contagious. A similar club was started at the state sanatorium. In a letter received not long after from the chief engineer he said: "Our club is getting along fine. At the last meeting we had four reels of moving pictures—two reels were of the General Electric Shops at Schenectady, N. Y., and the other two were of the Ford shops. I wish to say that the boys take a lot of interest in the club. There seems to be more team work since we started it. Everybody takes more interest in his work."

IN CONCLUSION

In this article there has been no attempt to discuss any theory, as such, or to describe plans for the future of this work but simply to present, with illustrations, what has actually been done in an educational way to increase the efficiency of the engineers and firemen of the Wisconsin state service.

The success of the movement is due not to any one department, commission or board, but to the coöperation of all. It is the result of the application of the idea that the lasting kind of efficiency comes only from within an organization and is based upon a thinking, alert and growing personnel.

"There is no higher ambition than that of serving the state, nothing more creditable than to serve it well."

WAR-TIME ACTIVITY IN THE CENTRAL WEST

Men with central-station experience have been particularly needed in the war because of their engineering training. The percentage of forces of the Middle Western companies in service ranges as high as 20 per cent. One company raised a complete unit of engineers and turned it over intact to the government.

* * * * * * * * * * * * *

But the large task has been to maintain electric service to essential industries. It is a revelation to see how thoroughly and satisfactorily this has been done. It is also interesting that this phase of the work is not centered in cities. Companies of which little is known, and which must remain unnamed, have held government priority orders on all equipment needed to get certain work completed and energy on new lines. In obscure communities central-station service is proving invaluable in underwear and clothing establishments working on khaki-colored cloth. In the larger cities the same condition prevails to an even greater extent.

At one city in Indiana 80 per cent. of the labor employed is absolutely dependent on central-station power. Several companies have reported 35 per cent. increase in industrial power load on account of munition business. Another company in an industrial city sold in October 42,213,000 units of service. Of these, 27,353,000 were for industrial power and 6,643,000 for transportation. A very large part of the total central-station output is going to essential industries. Among these are metal mills, mines, powder mills, shipyards, cereal works, cement mills, tire factories, overalls and apron factories, glove factories, producers of automobiles, tractors and tanks, and a thousand others.

Leaders in the industry see the silver lining without overlooking the cloud. They see definite good accruing to central-station companies from the present conservation program. Past growth has been so rapid that capital expenditures have been on a stupendous scale. The present program of saving is certain to bring to the surface investment economies as well as operating economies. It may be expected, in the opinion of Central Western officials, that this program of saving will affect the whole American nation so that when the war is over not only the utility companies but also a large percentage of individuals will have learned a lesson in thrift which no other single force could teach. —*Electrical World, N. Y., January 5, 1918.*

Intangible Values and War Tax

Will Congress Modify the Terms of the War Revenue Act to Provide for Capitalizing Intangibles?

By Charles W. McKay

An analysis by means of illustrations of the war tax on business to show how important are the problems surrounding the determination of the intangible assets. The author quotes a decision of an Iowa court and explains the method so established for determining the monetary equivalent of these assets.

Mr. Charles W. McKay *has been engaged in telephone engineering and appraisal work since graduating from Cornell University in 1906. He has been associated with the New York Telephone Company, Henry Floy, and the McCall and Clark Company. At present he is affiliated with the engineering firm of McMeen and Miller, devoting the major part of his time to problems of appraisals.*

IN October, 1917, Congress passed an act that will have a far-reaching effect upon industrial interests, the War Revenue Tax Act. This act owes its inception to a most laudable idea and it is far from the purpose of this article to criticize Congress—or any department of the Federal Government—in its efforts to raise the money necessary for the successful prosecution of the war with Germany. Every reader of INDUSTRIAL MANAGEMENT, and every contributor to its pages, is unquestionably imbued with the same spirit—a spirit of helpfulness, regardless of cost or of personal sacrifice. However, when a legislative body, after six months of deliberation, passes a bill which falls so far short of the purpose for which it was ostensibly designed, one may be pardoned a little curiosity as to its possible effect upon the various interests which it involves.

The intangible factors in industrial business contribute heavily to the earning of profits. They are one of the props of success. These factors include competition, patent rights, reputation for integrity, personnel of the directorate, trade names, market conditions, pending orders, location, publicity, credit and annual earnings. An Iowa court has declared that the most satisfactory manner of determining the monetary value of intangible assets is to take the average yearly earnings over a period of three or five years of uneven earnings as a basis. From this average deduct the amount of the interest on the average capital employed during the same years, figured at the rate of seven per cent per annum. The actual surplus profits thus ascertained may then be multiplied by some proper factor to determine the value of the intangible assets.

The act of October, 1917, provides for a strict censorship of the earnings of industrial concerns, and further provides the right of taxation on all earnings which, under the terms of the act are deemed to be in the nature of excess profits. So far so good—no one criticizes the right, moral or legal, of a war tax on *excess* profits—providing that they really are *excess* profits.

Under the terms of this act industrial organizations, whether they be incorporated or "personal" companies, are not permitted to capitalize intangible assets as a part of the base used in computing taxes unless these intangible assets have been actually purchased with cash.

It is a well known fact that many of the smaller industrial companies—and for that matter many of the larger ones—have a comparatively small amount of capital tied up in actual physical plant. The physical plant represents but the bare bones of the business, and in the case of many companies, unless imbued with life it is worse than useless. "Life" in the case of an industrial organization means business, and business values are always built up of such items as good-will, going value, contract values and patent rights.

EXEMPTION ON INVESTED CAPITAL

The act of October, 1917, stipulates that corporations or private individuals engaged in industrial business shall be allowed a certain return exempt from taxation on the "invested capital." It further provides a sliding scale of taxation on all earnings in excess of the exempted amount. Invested capital, however, includes only the capital represented by the physical property, unless the company is able to show that it has actually paid cash for its intangible assets. In this latter case, if it has paid cash for the intangible assets, these assets may be capitalized in an amount not to exceed the value of the tangible assets if the company *is not* incorporated. If the company *is* incorporated it can only capitalize the tangible assets at an amount not to exceed 20 per cent. of the value of the tangible assets as found.

AN ILLUSTRATIVE CASE

To see just what this means in actual practice, let us assume a theoretical case. The John Doe Manufacturing Company—a private, or unincorporated firm—is manufacturing a useful commodity. The business has been built up, and the good-will established, after years of hard labor on the part of the members of the firm. Many of the articles manufactured are protected by patents. These patents have been the result of arduous labor on the part of members of the firm, and before they were perfected involved appreciable expenditures in their development. The ratio of these expenditures to the real value of the patents to the company, however, is small. All of the intangible assets, patent rights, copyrights, trade marks, good-will and business value, represent years of labor on the part of the firm and its employees. The invested capital upon which the firm is allowed to earn a certain return exempt from taxation, according to the terms of the act of October, 1917, includes:

1. Actual cash paid into the business.
2. Actual cash value of tangible property (other than cash) paid into the business.
3. Actual cash value of patents, copyrights, trade marks, good-will and other intangible property paid into the business at the time of such payment *if payment was made therefor specifically as such in actual cash or tangible property.*

In the case under consideration the company has made no cash payments for its intangible assets. The intangible assets have cost the company a good deal of money but they have not been purchased outright for cash. Under the terms of the act these intangible assets must be entirely excluded from the invested capital. The invested capital, therefore, really represents only the value of the physical property and the cash, or funds, on hand for operating the business. The company finds, after a careful appraisement that its tangible property is worth $500,000. This sum represents the reproduction cost of the property plus an allowance for working capital, etc.

Due to the immense expenditures the company has had to meet in building up this business it has only been able to earn a return of 8 per cent. on a valuation of $500,000, for the past several years, and no return on the brains and labor involved in building up the intangible assets. During the present year, however, we find that the company has earned $200,000. Let us see what happens to this $200,000, when the tax adjusters get at it.

Private corporations are entitled to a flat exemption of $6,000. They are also entitled to a return on the invested capital—in this case $500,000—based on the earning rate prevalent for the pre-war period. In the case we are considering this rate of earning is 8 per cent. and the additional exempted amount is 8 per cent. of $500,000, or $40,000. The total exemption, therefore, amounts to $46,000, and the amount of net income subject to taxation is $200,000 less $46,000, or $154,000.

The computation of the taxes on the $154,000 follows:

	Tax
20 per cent. tax on net income in excess of total deduction ($46,000) and not in excess of 15 per cent. of invested capital for taxable year ($75,000) being $29,000....	$5,800
25 per cent. tax on net income in excess of 15 per cent. and not in excess of 20 per cent. of invested capital for taxable year, being $25,000	6,250
35 per cent. tax on net income in excess of 20 per cent. and not in excess of 25 per cent. of invested capital for taxable year, being $25,000	8,750
45 per cent. tax on net income in excess of 25 per cent. and not in excess of 33 per cent. of invested capital for taxable year, being $40,000	18,000
60 per cent. tax on net income in excess of 33 per cent. of invested capital for taxable year, being $35,000	21,000
Total tax for taxable year.............	$59,800

The total taxes of the company, therefore, amount to $59,800, or 29.9 per cent. of the company's net income of $200,000.

Further Illustration

Now, let us assume, to illustrate the workings of the tax law, that the John Doe Company had sold its property and business—said business including all good-will, patent rights, trade marks, business values, etc.—to the John Smith Company for the sum of $800,000, and that the sale was effected prior to October, 1917. In the terms of the bill of sale it was stipulated that the John Smith Company should pay to the John Doe Company $500,000 in cash, for the physical property and $300,000, in cash, for the intangible assets, such as good-will, etc. Inasmuch as the John Smith Company has paid cash for the intangible assets it is entitled to include them in the invested capital.

We may assume that the John Smith Company also earns $200,000 during the first year of its ownership of the property. According to the terms of the tax law it will be entitled to a flat exemption of $6,000, plus 8 per cent. on the invested capital ($800,000 in this case) or a total of $70,000. The amount subject to taxation is $200,000 less $70,000, or $130,000. The computation of the taxes on this residue of $130,000 follows:

20 per cent. tax on net income in excess of total deduction ($70,000) and not in excess of 15 per cent. of invested capital for taxable year ($120,000), being $50,000..	$10,000
25 per cent. tax on net income in excess of 15 per cent. and not in excess of 20 per cent. of invested capital for taxable year, being $40,000	10,000
35 per cent. tax on net income in excess of 20 per cent. and not in excess of 25 per cent. of invested capital for taxable year, being $40,000	14,000
Total tax	$34,000

The total taxes of the John Smith Company amount to $34,000, or 17 per cent. on its net earnings, as against taxes of $59,800, or 29.9 per cent. of the net earnings, for the John Doe Company. In other words, the mere fact that the John Smith Company has paid actual cash for its intangible assets entitles it to a reduction in taxes of $25,800 for the year. Obviously these intangible assets, when they were in the possession of the John Doe Company, were of appreciable value or the John Smith Company would not have purchased them for $300,000. However, the John Doe Company, which created the intangible value, could not, under the terms of the act include any allowance for intangible assets in its invested capital.

If either the John Doe Company or the John Smith Company had been incorporated still another story would have to be told. Briefly, the John Doe Company would be about in the same predicament as if it were a private company. The John Smith Company, however, having paid $300,000 for the intangible assets would only be allowed to capitalize them at 20 per cent. of the value of the tangible assets or $100,000.

Increased Importance of Intangible Values

All of this discussion is by way of preface to the following remarks on industrial intangible values. The act of October, 1917, has been subject to comment and it is not improbable that some of its problems will be reconsidered by Congress, among others, the question of making some provision for the capitalization of intangible assets, where such intangible assets have been brought into being as the result of years of hard labor in building up a business and represent a very real monetary value to the owners of the business.

It therefore behooves industrial managers to give this question of intangible values just as careful consideration as they would accord to the subject of purely physical values.

Fortunately the courts have established a precedent for the consideration of the value of the intangible assets in industrial appraisement. The writer has reviewed all of the American and many of the English cases involving intangibles, but has only been able to find one method of computing their value. This method is well illustrated in the following recent decision of an Iowa court:

> Good will is an asset in a class by itself. Its intangible nature makes it an excuse for manipulation. The difficulty in dealing with this item is in the measurement of its value. It is uncertain but the courts protect it and declare it to be an asset. Business men and theorists insist that it be treated as property. Negotiable good will is the exception rather than the rule in business. Can the value of good will be anything more than each man's guess? Emerson said "Every successful business is the lengthened shadow of some one man." Good will depends upon varying contingencies and upon numberless factors whose vital value may change with the moon. But there are rules for measuring it which have met with favor. The factors which go to make good will are competition, patent rights, reputation for integrity, the personnel of the directorate, trade names, market conditions, pending orders, location, publicity, credit and annual earnings. These are the props upon which good will is reared. All these factors contribute to the earnings of profits. The most satisfactory manner of determining the value of good will in dollars and cents is to take the average yearly earnings over a period of three or five years of uneven earnings as a basis. From this must be deducted interest at the rate of seven per cent on the average capital employed in such years. In this way we ascertain the actual surplus profits of the business. How many times then should these surplus profits be multiplied to get the value of good will? The answer can only be found in the peculiar facts of each case. I do not consider that in any case (except perhaps one of monopoly) the multiplier should be greater than two. In this case the average earnings covering a five year period (1906 to 1910, inclusive) are shown to have been $620,219.62. Deducting from this sum seven per cent on the average investment of $1,160,304.28 leaves a net surplus to be capitalized of $538,998.32.
>
> By applying the accredited rules for computing the value of good will to these computations, a valuation much larger than I have placed on the intangible values of the common stock might easily be found. From a full consideration of the case in its various aspects, however, I am convinced that the valuation of $600,000 which I have placed on these intangible values is one which would have been just and equitable in defendant's dealings with the plaintiff.

This decision is most interesting—it not only clearly establishes a precedent for including the "intangibles" as a part of an industrial company's assets, but it also outlines a method for computing the value of the intangibles. It will be noted that the court describes the intangibles collectively by the term "good will." By good will the court undoubtedly means "total intangible value." The synonymous use of the terms good will and intangible value is prevalent in industrial legal cases. This is unfortunate, as it is apt to lead to confusion. Intangible value, as already suggested, includes other items besides good will, i. e., value of patent rights, value of trade-marks, going value and contract values.

Anyone who is at all skeptical as to the wisdom of including the intangibles as a part of the invested capital will find convincing proof that the intangibles have a very real value in the decision of this Iowa court. In the passage just quoted, the court says: "It (intangible value or good will) is uncertain, but the courts protect it and declare it to be an asset." In another portion of the same decision the court says: "Good will is, in fact, a fixed asset, * * * and the good will of the company is of substantial value."

Method of Computing Intangibles

Possibly the court's method of computing the value of the intangibles may be made clearer by a simpler illustration. Take, for instance, the case analyzed in an earlier portion of this article, that of the John Doe Manufacturing Company. The physical property is valued at $500,000 and the company has a net income of $200,000 a year. Applying the method of the Iowa court, a fair return—say, 8 per cent.—on the value of the physical property should first be deducted from the $200,000 net income. Eight per cent. of $500,000 is $40,000, and the "surplus profits" amount to $200,000 less $40,000, or $160,000. The value of the intangible "something" that produces these excess profits of $160,000 is uncertain, depending upon the stability of this portion of the net income. In the case of the John Doe Manufacturing Company it was assumed that the company had struggled along for many years, earning a return of only 8 per cent. on the physical property, and that it had just reached the point where it was beginning to realize a return on the immense amount of labor involved in building up the business. Following the precedent of the Iowa court, we would not, in this case, be justified in assigning to the intangibles as high a value as if the company had been maintaining an income of about $200,000 a year for a number of years preceding the appraisal.

In all probability if the court in question had been confronted with the task of assigning a value to the intangibles of the John Doe Manufacturing Company, it would have appraised them at $160,000, the amount of the surplus profits for the current year. If, however, the company had maintained an average in earnings of $200,000 for, say, five years preceding the appraisal, there is ample precedent in other court cases for the capitalization of the intangibles at as high as 20 per cent. If the $160,000 surplus profits accruing from the intangibles were appraised at 20 per cent., the value of the intangibles would be $800,000—in other words, they would be worth much more than the purely physical property.

The method outlined in the foregoing decision has one marked defect, it does not provide for the segregation of the various elements of intangible value. The items component to the total intangible value of an industrial organization are so diversified that it is most desirable to find some means of computing their respective values. The method suggested in the following paragraphs has ample precedent in the public utility field and there is no reason why it should not be equally well adapted for use in the industrial field.

Value of purchasing contracts. Taking up the various elements of intangible value in the order in which they are enumerated in Table I, we have first, the value of the purchasing contracts. Many industrial organizations are fortunate enough to possess long term contracts for the purchase of their fuel and raw materials. A company may have a contract with a coal-mining company which calls for the delivery of a certain specified amount per annum at a fixed price or at a price based upon a flat amount per ton and subject to certain increases, or decreases, in the event of a rise or fall in the labor market. Obviously such a contract is a very real asset to the industrial company possessing it, and the value of this contract is a part of the total intangible value.

To show the correlation between the various elements of physical property and the elements of intangible value an hypothetical case has been assumed as illustrated in Table I on the next page.

TABLE I. RELATION OF INTANGIBLE TO PHYSICAL PROPERTY

Item	Reproduction Cost	
Direct construction costs:		
Inventoriable property	$407,000	
Omissions and contingencies	16,500	
Purchasing expense	8,250	
Tools and tool expense	8,250	
Total direct construction costs.		$440,000
Collateral construction costs:		
General and legal expense	$ 21,000	
Engineering and general supervision	20,000	
Taxes and insurance (during construction)	5,000	
Interest (during construction)	14,000	
Total collateral construction cost		$ 60,000
Total physical property		$500,000
Non-physical (or intangible) assets		
Value of purchasing contracts		
Value of patent rights		
Cost of establishing business (or going value)		
Cost of financing		
Value of good-will and trade-marks		
Total non-physical assets		
Total value (on a reproduction basis) of plant and business.		

The following method of determining contract values has a precedent in public utility practice. We may assume that an industrial company has a contract providing for delivery of coal at $2 a ton, for a period of five years and that three years of the life of the contract have elapsed at the date of appraisal. During these three years the company has had an average consumption of 5,000 tons per year, and it seems reasonable to assume that a similar amount will be required during the unexpired term of the contract. The total estimated consumption for the five-year period is then 25,000 tons and the cost of the coal at $2 per ton is $50,000. We may also assume that the average market price for the grade of coal used by the company for the three years has been $3 per ton and, further, that the company is warranted in assuming that the market price for the unexpired term of the contract will be at least $3 per ton. Therefore, if the company had been obliged to purchase its coal in the open market it would have had to pay $75,000 instead of $50,000, and under the terms of its contract the company has saved $5,000 a year. The value of the contract to the company may be determined by capitalizing the $5,000 annual saving at 8 per cent. on the assumption that 8 per cent. represents a fair rate of earning for the business; $5,000 capitalized at 8 per cent. is $62,500. The fact that the contract has only a five-year life should be cared for by depreciating the $62,500 value at the rate of 20 per cent. per annum.

The foregoing method was advocated by the Public Service Commission of St. Louis in the appraisal of the property of the Union Electric Light & Power Company.

Value of patent rights. Undoubtedly the appraisement of the patent rights of an industrial company is one of the most exacting problems involved in the determination of the intangible values. The following method seems reasonable and can undoubtedly be substantiated before the courts. It is first necessary to analyze a company's net income and determine what proportion of the income results directly from the sale of patented articles. Obviously, after the patents have expired this portion of the income will be materially reduced, due to the fact that the company's competitors will have the privilege of manufacturing the same, or very similar articles. During the life of the patents, therefore, the patent rights have a real monetary value and this value may be measured by the income resulting directly from the sale of the patented articles.

We may assume that the company under investigation has an income of $200,000 a year, and that an analysis of this income shows that $100,000 may be attributed directly to the sale of patented articles. This $100,000 income accruing from the patent rights, will be materially reduced when the patents become public property. It is probable, however, that the company will still be able to derive some revenue from the sale of the articles in question after the patents have expired—in competition with other companies. We may assume that an estimate of a revenue of $40,000 a year from the sale of the patented articles—after the expiration of the patents—has been agreed upon as conservative by the officials of the company. The income that may be attributed directly to the patent rights is, therefore, $100,000 less $40,000 or $60,000. The valuation of these patent rights may therefore be effected by capitalizing the $60,000 income at 8 per cent. and the value of the patent rights would, in the case under consideration, be $60,000 divided by 8 per cent. or $750,000.

Obviously a rate of return as low as 8 per cent. would only be justified if the income resulting from the sale of the patented articles had been maintained at about the same rate over a long period of time. In the case of the John Doe Manufacturing Company previously referred to, where the net income has experienced a marked rise within a comparatively short time, the patent rights would have to be capitalized at a much higher percentage and the value of the patents would be very much smaller.

Cost of establishing business. Cost of establishing business, or going value, is frequently confused with good will. These two items of intangible value are, however, entirely separate. The cost of establishing the business may be defined as "the cost of acquiring the net income prevailing at the appraisal date," or as "the amount resulting from the capitalization of the losses incurred in building up the business."

There are three distinct elements involved in the computation of the cost of establishing the business. These elements are:

(a) Cost of organization and development during business building period.

(b) Cost of securing customers.

(c) Net interest on the operating losses during the business development period.

Organization and development. In establishing a new business it is self-evident that an organization—including the executives and employees of all of the departments—cannot be gathered together without an appreciable expenditure of money. The expense involved in building up an organization usually bears a fixed ratio to the reproduction cost of the physical property. In public utility practice there is ample precedent for an allowance of 2½ per cent. of the cost of the physical property to cover the cost of building up an operating organization. In industrial practice the determination of this percentage is largely dependent upon the exigencies of the case under consideration. It is possible, however, to determine a percentage for any given industrial appraisement that will be susceptible to substantiation.

Cost of securing customers. No industrial business can be built up without the expenditure of a large amount of money for the securing of customers. This cost resides in the salaries and expenses of salesmen, in advertising and in the accompanying clerical expenses. It is possible, by making a careful analysis of the company's expenses over a period of years, to determine a cost per customer, and this actual cost per customer, as determined from the company's books, when multiplied by the total number of customers on the books at the date of the appraisal, will give a conservative estimate of the expenditures involved in this portion of the business building process.

Net interest and operating losses during development. In public utility practice it is customary to compute the interest and operating losses during the business developing period of determining, as accurately as possible, the length of time that would be required to reproduce the business as it stands at the date of appraisal, and by subsequently computing the interest and operating losses as incurred during this period. In the space assigned to this article it is impossible to give a detailed discussion of this phase of the problem. Suffice it to say that the same method is applicable to industrial appraisals and that the interest and operating losses during the business developing period may be computed with a reasonable degree of accuracy.

Cost of financing. Needless to say there is always an expense involved in the marketing of industrial securities. To illustrate, the securities of a certain industrial concern may have a par value of $100. In financing the business it will probably be found necessary to sell the securities far below the par value. If we assume that the securities in question are sold to the public for $90 and that the fiscal agents involved in the transaction charge a commission for their services of 2½ per cent., the total cost of financing for each $100 will be $100 less $87.50, or $12.50. In other words, for each $87.50 the company receives it will have to pay back $100 and it therefore incurs a net loss of $12.50.

This cost of financing is a very real element in the total cost of creating a business and if the business is being appraised under the reproduction cost method some allowance for financial costs should be made.

Value of good-will and trade-marks. The value of good-will and the value of trademarks are so closely allied that it is almost impossible to effect a segregation in computing their monetary equivalent. The only method of estimating the value of good-will that has yet been advanced is the one advocated by the Iowa court in the decision already referred to. This method, however, will have to be slightly modified to meet our present requirements. Referring again to our illustration of a company whose physical property is valued at $500.000 and whose net income for the year preceding the appraisal amounts to $200,000, the value of the good-will may be computed as follows. We may assume that the value of the various other items of intangible value have been computed by the methods outlined in the foregoing paragraphs with the following results:

Value of purchasing contracts.....	$62,500
Value of patent rights............	60,000
Cost of establishing business......	50.000
Cost of financing................	62,500
Total	$235,000

The value on a reproduction basis of the physical property and of the intangible as thus far computed is $500,000 plus $235,000 or $735,000. The return of 8 per cent. on $735.000 amounts to $58,800. The amount of net income which may be attributed to the good-will of the business is, therefore, $200.000 less $58,800 or $141,200. Inasmuch as the company has maintained its present income —$200,000—for only one year, we probably will not be warranted in capitalizing the earnings resulting from the good-will at less than 100 per cent., and the value of the good-will in this case would, therefore, be $141,200. This added to the value of the intangibles as already computed gives a total intangible value of $376,200, and a total value for the plant and business of $876,200.

Undoubtedly, the new War Revenue Tax Act will play a most important part in industrial financing. It will present many interesting and unusual problems to the industrial manager. Whether or not Congress will modify the terms of the act to provide for the capitalization of hard earned and properly constituted intangible values we do not know, but there is reason to believe that the ultimate outcome will be satisfactory to all of the interests involved.

If industrial companies are allowed to capitalize their self-created intangible assets, there is ample precedent for determining their monetary equivalent by the method of the Iowa court, as described in this article.

How to Study Labor Unrest

By Ordway Tead

Partner, Valentine, Tead and Gregg

THE protracted stay of the President's Labor Commission upon the Pacific Coast has convincingly dramatized the imperative need of careful analysis as a corrective and preventive of industrial controversy. This body has been in the West because our war time labor policy can neither be adequately formulated nor effectively administered unless there are officials going up and down the country probing to the bottom of the sources of unrest. Unfortunately the idea that all disputes resolve themselves into a wrangle over wages and hours has gained wide acceptance. This is not true; it is an over-simplification which especially in time of war becomes a subtle form of blindness to important facts. So that if this commission was doing nothing else, its work would be amply justified by its success in showing the country that there is no royal road to understanding or adjustment of labor ills. This is the first step toward a realization that profound study of industrial relations requires a method of analysis, a systemized attempt to take account of all factors in every situation. That the commission has performed this necessary service presumably without direct intent in no way detracts from its value.

It has emphasized by its method of study that the causes of acute disturbance are legion and often complex; that avowed causes may not be the real ones since either side may give out statements intended to throw the public off the scent; and that occasionally in the heat of controversy real provocations may be lost sight of, or may never have been definitely framed. To be sure, the truth of all this has been abundantly illustrated in the strikes of the last six months. The published reasons for these stoppages include dislike of foremen or other minor executives, disapproval of methods of discipline and of conducting grievance committees, aversion to the introduction of scientific management, refusal to tolerate the existing form of discharge book, and employers' unwillingness to deal with the unions in any way, including particularly their unwillingness to run a union shop.

Sources of Unrest Lie Deep

But it has taken the public entry into the West of personal representatives of the President to teach us that the sources of unrest are not to be generalized about and are not disclosed by superficial observation. That their discovery requires time, sympathy and immediate contact with the particular situation goes without saying. But until recently it has not been less clear that successful investigation requires a technique of analysis, a formal method of inquiry calculated to reveal in the course of its thorough application every possible occasion of disruption and discontent. The success of the President's Commission makes it plain that whatever its plan of attack be called it does in fact include the use of such an exhaustive technique of study. This being true, attention should be directed to its extension.

Of course, the need of a certain amount of investigation in the work of the various wartime labor adjustment boards has already been recognized. District examiners have been specifically provided for several boards; otherwise official inquiry into the facts of a crucial situation is usually required. If one coördinated Bureau of Industrial Relations is created to work for the correlation and coördination of all national labor matters, it will presumably set in motion the machinery for elaborate and extensive investigation into the enforcement of existing agreements, and into conditions and terms of employment in war industries. But all this, admirable and necessary as it is, is not enough. The success of these several agencies will be endangered and their usefulness minimized if there does not exist for their use a precise weapon of search, a nice instrument of inquiry with which they can probe to the seat of existing but concealed irritation. The effective investigator is not the one who comes with the question, "What is the trouble here?" The questions to be put are penetratingly specific. They must be framed in the light of all the known causes of discontent with a patience and insight that follows to its end every suggestion and clue, and drives into the open every detail.

Methods of Scientific Analysis

This application of methods of scientific analysis to problems of industrial relations has become wholly feasible. Gradually in the last forty years the whole field of productive enterprise has become the object of careful study, measurement, record-keeping and graphic report. The development of accounting is a case in point. The use of a prescribed plan of study and report in the investigations of the Interstate Commerce Commission into the accounts of common carriers affords a familiar and close parallel to needs in the realm of labor adjustment. This Commission can demand any and all data which it finds necessary to protect the interests of parties to the financial transactions of the carriers, and it requires that information be furnished in a uniformly prescribed manner. Similarly, the increasing use of cost-accounting in private business means the building up of an analytical method, the creation of records from which all elements of cost can be identified, isolated and studied. Accounting, auditing, cost-accounting—these are simply the technique of inquiry into facts which are indispensable to a judgment as to the financial security and integrity of a going business. This technique is less than half a century old and is still developing, but the logic of its usefulness in the overwhelmingly detailed transactions of large-scale business is already established beyond debate.

Unfortunately this cannot yet be said of the technique of labor investigation. It is still in the making, and its validity or necessity is not yet universally admitted. But the work of facilitating production and eliminating petty frictions in the munition industries requires that we apply the logic of this analysis to labor problems and develop a labor audit for our purposes by the experimental method. Such an audit will provide a method of systematic study and report upon all elements and influences in a factory or industry which obstruct the output and determine the attitude of the workers to the management.

Labor Audits in Industry

Happily we are not without material out of which this audit method can be elaborated. Labor audits have already been successfully made in various types of industry. The items which should be studied to get a comprehensive view of the sources of unrest have by this time been recognized, named and compiled by private foundations, students of industry and industrial engineers and consultants. There are moreover numerous intelligent labor leaders who could name offhand a hundred causes which in their experience had resulted in disruption or discontent. To whatever body the task of systematic investigation of the sources of unrest in munition industries may be committed, its first crucial duty should therefore be to formulate the outlines of a method of procedure for its factory investigators or examiners. The successful accomplishment of this first step will, of course, depend upon the composition of the board or bureau to which it is entrusted. But if the best precedents of war organization are followed this body will have the benefit of the special points of view and interests of employers, employees and government officials. Through this three-fold participation in the drawing-up of check lists and questions for investigators, the government will have at its disposal a method of discovering sources of unrest which will be sufficiently inclusive in scope for all practical purposes in the immediate crisis, and which can be improved to allow for more penetrating analysis as increasingly complicated problems come to light.

Advantages of a Technique of Inquiry

Two advantages of a technique of inquiry at once suggest themselves. Its use would bring to the surface difficulties for which the remedies would almost immediately suggest themselves, and the possession by an official bureau of the right kind of facts compiled in the right way would have an immensely salutary influence on the conduct of personnel administration in private industry. In addition to these preventive values there is the economy to be effected in the time of investigators at factories. Given a knowledge of all conceivable sources of potential unrest, it is possible to hunt them down far more quickly than when only a general knowledge of industrial bills is utilized. Rapid diagnosis requires that all known symptoms lie in the front of the diagnostician's mind. The direct economies in manufacturing processes to be achieved by using a labor audit are also too substantial to be ignored.

The high labor turnover, inadequate training, archaic and wasteful methods and arrangements of work and working conditions which incisive study so often reveals, can and will in the war demand for output be corrected as soon as they are known. Finally the fact of sure and expert study and grasp of each individual labor situation by government officials will go far toward convincing the workers of America that at this time their interests are not being jeopardized, and that their welfare is receiving equal consideration with that of every other group which has put its services unreservedly at the disposal of the country.

If, therefore, we are to make it safe for the working man to give rein to his sense of national loyalty we must not only create an effective national investigative body, we must also equip it with instruments of precision which when tactfully and honestly used will detect the sources of unrest.

Getting the Most Out of Index Cards

Notched Cards Can be Filed to Give Information Graphically

By F. J. Schlink

Large-scale methods of card sorting are well known, but are too expensive to use in the average industrial plant. To obtain corresponding results with simple means the author suggests notching the perimeter of the cards in various ways to indicate particular characteristics. Numerous illustrations fully explain the plan.

Mr. Frederick J. Schlink *was graduated from the University of Illinois in 1912 and received the professional degree of mechanical engineer in 1917. During the past five years he has been in the employ of several manufacturing firms in the middle West, and is now associate physicist in the United States Bureau of Standards, specializing on the design of measuring machines and instruments. He is a junior member of the American Society of Mechanical Engineers and a contributor to the technical press.*

THE flexibility of card systems and their well-recognized adaptability to a wide range of uses have made them an important factor in industrial administration. In many applications they have displaced the the book record, on account of the special conveniences they afford. Recently while making use of index cards for statistical purposes where economical routine methods in the handling of the material were essential on account of the large amount of data to be digested, the author has devised and extended certain simple and effectual methods of using cards, which can be employed in many lines of work to good advantage. The use of these methods relates principally to the rapid classification of a large amount of individual data according to any number of coördinate characteristics or criteria.

The well-known large-scale methods of card sorting of the Bureau of the Census (see Figure 1), which are employed to a considerable extent also in the cost-accounting and sales analysis of large industries, are excellent where the amount of work to be done warrants the investment in the highly organized and complex machinery required. In this method the cards are punched at various points over their area by a key-operated recording machine, and sorted by machines which utilize the position of these punched holes to actuate an electric or pneumatic separation mechanism. By the use of these machines, it is possible to separate at will from a group containing millions of cards, all those having a given characteristic or combination of characteristics, counting these cards at the same time and recording on a tabulation sheet the number separated.

Another method but recently proposed and placed on the market, is better adapted to needs not warranting the large initial expenditure of the scheme briefly sketched above. By this method the cards are prepared for use by being punched with round holes at definite and uniform intervals over their whole area; when it is desired to record a characteristic corresponding to a given location of hole, that hole is enlarged to an oval slot extending in the vertical direction of the card. All of the cards recording a given characteristic may then be designated by passing a rod through all the cards transversely to the plane of the cards, through the line of holes corresponding to that characteristic. When this is done and the card drawer is inverted, all those cards having slots in this position will slide out beyond the other cards to the limit allowed by the length of the slot, while those in which the hole has not been elongated will remain fixed in position. If several rods are inserted, only those cards recording *all* the corresponding characteristics will fall, and it is therefore possible to apply simultaneously as many criteria as desired.

The method here proposed by the author instead of using the area of the card for recording the data, which requires a more or less complicated classification means of a mechanical character, employs the perimeter of the card for the recording of the characteristics. At stated positions on the perimeter, semi-circular, triangular, or other conveniently shaped notches are cut by a punch, each position corresponding to a particular characteristic. This method has already been applied to a small extent in card index work, as in the following example.

Suppose a factory maintenance system requires that each of a certain group of machine tools be given a bi-monthly inspection. The cards corresponding to these machines will be arranged, say alphabetically, by name of the type of machine, and the inspection of the machines may take place in any convenient order, as by their location in the plant. As each machine is examined, a notch is cut in the edge of the card in a position corresponding to the particular bi-monthly period, while the proper entries are made on the face of the card, covering the nature of the repairs or alterations, changes in the location of the machine, etc. The cards are returned to the drawer as fast as the entries are made. At the end of the inspection period it can be seen at a glance whether all the machines have been inspected, and if not, which remain to be given attention, this information being clearly disclosed by the projection of the unnotched cards in the line of the notches on the other cards. When all the machines have been given their regular inspection, a groove consisting of a continuous line of notches from front to back of the drawer, will appear in that position corresponding to the particular period in question. See Figure 2.

This device is clearly a useful one. The cards notched as described provide the same convenience in checking off finished work as does an inventory list with a column for check marks, while offering in individual arrangement and space for notations the flexibility of the ordinary card index. The same principle is involved in the method of tearing off a corner or corners of a card, as was used for racial identification in the recent war registration, though, of course, only four characteristics can be so indicated.

The characteristics defined by the method of punching the perimeter of cards may be purely descriptive, as the name of the maker (in the case of a machine, as in the previous example), the style, the kind of finish, the kind of accessories, etc.; or they may be numerical magnitudes, as the purchase price, the cost of maintenance, or the capacity (in number of pieces output per hour, the load carrying capacity, liquid containing capacity, boiler horsepower, gallons delivered per minute, and so on, according to the nature of the machine or instrument involved).

Figure 3 shows a tabulation card on which characteristics of both qualitative and quantitative types are recorded.

It is seen at once that the card here shown registers a non-automatic weighing scale of the portable platform type, made by the John Doe Scale Company, located in Building D, and having a capacity of approximately 1000 pounds. In addition the card has much of its area available for the entry of written data. Now suppose that we have, as is quite possible in a large industrial plant, a large group of such cards that are to be examined. If it is desired to discover how many scales are located in Building D, the position on the lower edge of the cards corresponding to Building D is noted, and followed back through the group along an imaginary line through this position. The cards satisfying this condition can be picked out at once and counted as rapidly as the eye can scan the block of cards and without the need of breaking their arrangement or examining them individually. Perhaps a new job requires the immediate employment of a scale having a capacity not less than 5000 pounds. When is such a scale to be had most conveniently? Following work along the 5000-pound line, we easily pick out the cards having notches at or to the right of that position, lift out each card, examine into its other characteristics as shown by the remaining notches and, by the inspection records on the face of the cards, quickly come to a decision. We may find for example that such scales are to be found in Buildings K, M and Q, but that only that in Building M was at the last inspection shown to be sufficiently accurate for our present purpose.

In case the number of cards is great, the method of successive selection just described may be inconveniently slow. To be sure it is far more rapid than any method of selection which requires the individual examination of each card, as is unavoidably necessary in the ordinary card index unless extensive cross-indexing is done, requiring a separate cross-reference card for every distinct criterion which it is expected will be required. However, when the great number of cards involved warrants it, the following method may be employed for semi-mechanical selection by characteristics successively applied. In the bottom of the card drawer there is placed at the proper position in one of a series of longitudinal grooves, a wire or rod of suitable diameter, lying parallel to the long axis of the drawer. The cards are replaced in the drawer in the ordinary manner, being thus superposed on the wire. This being done and the cards shaken down slightly, all those cards not having notches at the position in which the wire lies will be raised above their fellows by an amount equal to the depth of the notches, and if the cards are now picked up *en masse* and turned over, those which have not been raised by the wire may be easily extracted, the separation having thus been performed by a simple mechanical expedient. The same process may be applied for a second characteristic, if desired, to the group just separated, until finally we have isolated those cards which comprise all of the criteria applied.

It is believed that no other so simple and inexpensive means is available, for accomplishing the rapid application of a number of necessary criteria to an index or record file, either by simultaneous or successive classification. The device will be found useful for many purposes. A trial of this scheme, which involves no significant increase in the cost of the card file, which is applicable to all card record systems of small and moderate size and can be made to serve a useful purpose in even the largest card files, will suggest a multiplicity of uses. Even in its simplest form, in which the upper edge only of the card is notched, a great extension of the utility of the ordinary file can be immediately and cheaply obtained, while the need for extensive cross-indexing which would otherwise be necessary for close and analytical utilization of the data, is by this method successfully eliminated in nearly every case.

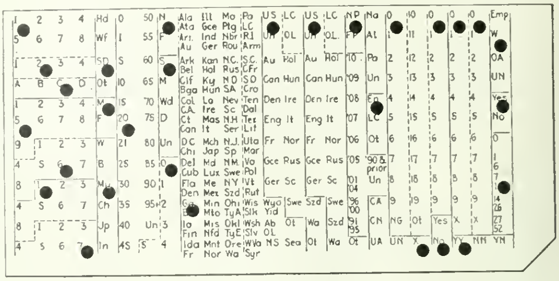


FIG. 1. CARD OF THE TYPE USED BY THE CENSUS BUREAU IN ITS AUTOMATIC SORTING AND TABULATING SYSTEM

The holes are punched by a special machine, operated from a keyboard

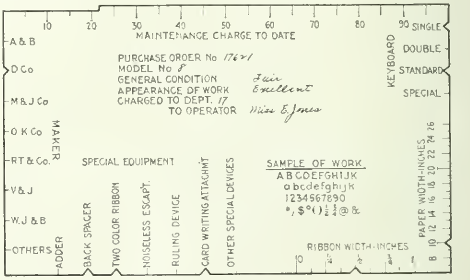

PURCHASE ORDER No 1761
MODEL No 8
GENERAL CONDITION Fair
APPEARANCE OF WORK Excellent
CHARGED TO DEPT. 17
TO OPERATOR Miss E. Jones

FIG. 2. NOTCHED CARDS OF WHICH THE UPPER EDGE IS USED TO INDICATE THE COMPLETION OF A PERIODIC INSPECTION

The cards corresponding to machines whose inspection is not yet completed can be readily noted by reference to the appropriate line of notches.

Any desired size of card can be used. The amount of perimeter available for record purposes increases as the sum of the dimensions, unlike the area available for writing, which increases as the product. A spacing of one-quarter inch between centers of punch marks for

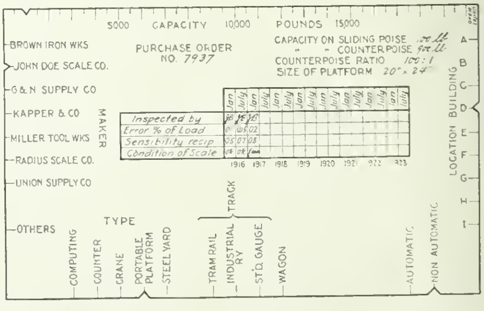
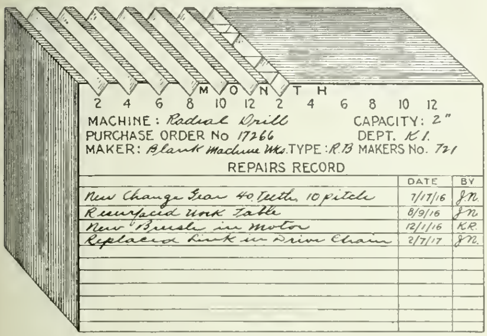

PURCHASE ORDER NO. 7937
COUNTERPOISE RATIO 100:1
SIZE OF PLATFORM 20" x 24"

FIG. 3. NOTCHED CARD OF WHICH THE WHOLE PERIMETER IS USED, SHOWING FULL INFORMATION IN REGARD TO A PARTICULAR WEIGHING SCALE

the qualitative data will be found satisfactory, while on the scaled edge data can be readily recorded to the nearest 0.03 inch, which gives a precision within 0.6 per cent. of the total range on the upper edge of 3 x 5 card, or within 0.4 per cent. on the same edge of a 5 x 8 card, For most engineering and cost-finding purposes this is amply accurate.

The load carrying capacity of a large traveling crane, for example, is given with more than sufficient accuracy if recorded to the nearest ton. The same is true of much other engineering data and of cost data of all ordinary sorts as well. In distributing overhead charges in plant operation, there can never be a reason for computing the cost of a lighting generator to the nearest cent, especially in view of the fact that there is often serious doubt whether the rate of depreciation to be charged off is to be 10 or 15 or 20 per cent. per annum.

In exceptional cases it may be desirable to add to the number of characteristics by using a color scheme in addition to the punching plan.



MACHINE: *Radial Drill* CAPACITY: *2"*
PURCHASE ORDER No *17266* DEPT. *K1.*
MAKER: *Blank Machine Wks.* TYPE: *R.B* MAKERS No. *721*

REPAIRS RECORD

	DATE	BY
New Change Gear 40 Teeth 10 pitch	*7/17/16*	*J.N.*
Resurfaced Work Table	*8/9/16*	*J.N.*
New Brush in Motor	*12/1/16*	*K.R.*
Replaced Link in Drive Chain	*2/7/17*	*J.N.*

FIG. 4. NOTCHED CARD USED AS RECORD OF TYPEWRITER EQUIPMENT
Note the manner of recording the increasing maintenance charge, here shown as $22

For every readily distinguishable color that can be employed, a new distinguishing characteristic is added, but it is to be kept in mind that the color scheme is not so effective for finding purposes as the notching method.

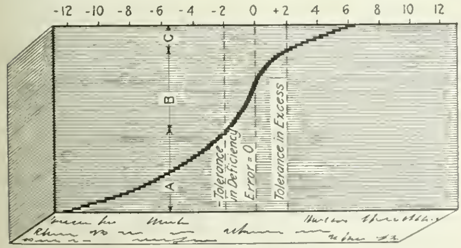


FIG. 5. SET OF 200 3 X 5 CARDS HAVING UPPER EDGES PUNCHED TO REPRESENT THE ERRORS (INACCURACY) OF EACH OF 200 PRESSURE GAGES

Cards are arranged in descending order of the notches, so that a smooth curve results, giving a continuous and graphic record of conditions. This method of recording is subject to indefinite expansion without rewriting or redrawing, and is applicable to many uses, as for example, the upkeep cost of a fleet of motor trucks, the wages of employees, etc. In the two examples just mentioned, no minus quantities are involved, so that the curves would lie entirely to one side of the zero line, which in such cases will be at the left-hand edge of the cards.

A. Number of cards showing gages having errors in deficiency, greater than the allowable tolerance 85
B. Number of cards showing gages having errors within the allowable tolerances.............. 87
C. Number of cards showing gages having errors in excess, greater than the allowable tolerance 28

Another sort of quantitative data often of value to record is that which is cumulative in effect, requiring the addition from time to time of new amounts to a value already recorded. This will occur in recording the total maintenance or repair charge to date on an item of equipment. In computing cost of typewriter equipment in an office, for example, it is necessary to know what has been the total cost of repairs on each machine. This sort of shifting value can be appropriately represented in the manner shown in Figure 4.

Special means for facilitating the rapid and accurate punching of the notches in the correct positions are easily prepared. In case the expense of printing the scale values along the upper edge of the card does not seem warranted, a stationary punch table may be provided so that the cards may be slid into register against a fixed stop, or against guides at right angles, for quickly establishing the zero point of the scaled edge. When such a stop or guide is used, the graduated scale for indicating the point to be punched may be so affixed as to lie contiguous to the edge of the card, thus making the accurate printing of graduations on all the cards unnecessary, and permitting the use of a single graduated scale for marking all the cards in turn.

In cases where the arrangement of the cards need not be fixed according to an alphabetic or subjective basis, the cards are best arranged in the ascending order of the values shown on the scaled edges. This arrangement carries a very interesting property, namely, the continuous display of the "distribution curve" as it is termed, of the data, that is the curve which shows the relative frequency of occurrence of a given magnitude or a given range of magnitudes. This property is most simply shown by reference to the following example.

In Figure 5 is seen the scalar edge of a group of cards representing the results of the test of an equal number of pressure gages, showing the errors in per cent. of the total range of the instrument. The alphabetical or subjective arrangement of the cards has been abandoned, and the cards arranged so that as we move to the right each scale value is less than the one which precedes it. A line connecting all the notches of the array of cards *seriatim* gives what is termed the frequency curve of the data under consideration. The properties of this type of graph are very useful and well deserving of examination. Such curves are now widely used in scientific studies of a statistical nature, from the mortality data of a life insurance actuary to the food plant measurements of the economic botanist.

In Figure 5, the errors determined on test are shown in the appropriate direction from the zero line *oo*, errors in excess lying above this line, errors in deficiency below it. Perfect accuracy in any instrument being of course unattainable, a certain limit of error is determined upon as permissible, and called the "tolerance." If the limits of tolerance are laid off at the correct distances on each side of the zero line, we may, by counting the number of cards having notches which lie within the limits of these two tolerance lines, determine directly the number of satisfactorily accurate gages.

Now if we wish to ascertain which maker's apparatus exhibited the smallest deviation from correct measurement, we may by a simple calculation from the group of cards representing his product, determine what percentage of gages of his make gave readings within the allowable tolerance, what was the mean error of all of that make under the test conditions, what the maximum error, and what proportion were exactly accurate (within the limits of observation).

Consider how valuable this sort of information is. In most well-managed industrial plants of large size, all the pressure gages are regularly tested and when found badly in error, adjusted. The dictates of both safe and economical steam plant operation require this. Suppose that the results of the tests are recorded in the manner outlined above, and it is found that, on the first test, 60 per cent. of the gages were accurate within the predetermined tolerance. Consider how useful to the purchasing agent is the information that one maker's products occur in a proportionately higher ratio than those of any other maker, in this superior 60 per cent. With this knowledge in hand one might readily calculate that important economy might result from paying a considerably higher price for gages of this superior make, when due account is taken of the cost of repairs, adjustments and rejections of inferior makes. No argument is needed to show that this sort of explicit analytical information would be discouragingly difficult to obtain by any other simple and conveniently available means.

The property of symmetry possessed by the frequency curve is often illuminating in the study of the data of such an investigation. It is seen that the curve shown in the figure is of the unsymmetrical type, that is, a much greater area lies within that branch of the curve to the left of the zero line than within the branch to the right of the zero line, showing in a graphic manner that the instruments tested had a decided tendency to be short in reading. This condition is a sure index of faulty design or inspection on the part of the manufacturer. It will be useful to determine by a brief examination of the cards, sorted by their notching, whether the tendency to "short" reading is common to all makes of this apparatus, or is peculiar to a few makes or types only.

Application to Labor Turnover

Consider the application of this method to the problem of labor turn-over, a question whose economic effect on business is growing to be more and more appreciated. For each employee a card will be filed, one edge being scaled to indicate the length of time that workman remained in the service of the firm. The frequency curve of these cards, giving the terms of service for every class of employee, when sorted into groups by departments by the methods already described, will enable us to draw instant comparisons between conditions in the various departments as regards turnover. This knowledge would almost certainly lead to improvements either in wages or in working conditions, to lengthen tenure, to bring about a better balance between departments in the matter of employment, and to effect real economies in the cost of maintaining a full working force.

The condition obtaining on any given date can be recorded by photographing the edge of the card showing the distribution curve. When the date and the number of the cards involved is noted on the print, a valuable and convincing record is permanently available.

It should be noted that the obtaining of an accurate frequency curve requires the use of cards of uniform thickness; there will be no difficulty in approximating this if standard grades of commercial cards are used.

Engineering Advice in Electric Power Contracts-Discussion

By Thomas Robson Hay

With Duquesne Light Company

IN a paper, "Engineering Advice in Making Electric Power Contracts," by Mr. A. Langstaff Johnston, Jr., published in INDUSTRIAL MANAGEMENT for December, 1917, criticism is made of the methods of the (average) central station in the negotiation of electric power contracts with a variety of industrial users.

The attitude taken is not an unfamiliar one and is largely, no doubt, the result of past policies of central stations in negotiating contracts and occasional abuses, perhaps, in isolated cases in present practice. It does not seem reasonable, however, to contend or infer that the abuses set forth in this paper are common to all central stations or are of frequent occurrence. Just like other corporations, central stations are apt at times and under peculiar circumstances, to diverge from the law of equal treatment to all, regardless of the size and character of the business under negotiation. Any large central station is like an individual. Some are known for right dealing and equality in treatment to all, just as some individuals are marked men on account of established reputations for integrity and just dealing. The right and fair way is always the best way in the long run, as it facilitates negotiation of contracts and reduces selling costs and overhead costs of service.

The author is impatient at the limitations of human authority and wisdom. His criticism and impatience with lapses, at times, perhaps, are evidence of this discontent. But there is a deeper source of impatience of which he is scarcely aware himself. Fundamentally, he has been driven back upon the eternal problem of man's incapacity for righteousness to which the modern world has become deadened. He has learned that formulated law is necessary and obedience to it a duty, but apparently forgets that the execution of every law so formulated falls short of the true and desirable standard by the conflict of human limitation and desire with this standard.

Mr. Johnston "tars" all central stations with the same stick. He has no remarks to make regarding the fairness and justness of the vast majority of central station negotiations. To one unfamiliar with central station practice, it would seem that this paper endeavors to convey the idea that the negotiations described are the rule rather than the exception, and that the central station plays the rôle of the "skinflint" in all negotiations, endeavoring to get the maximum income possible regardless of the merits of the individual case.

Electric Service Not Bargained For

It does not seem correct to say that electric service is "bargained for" when dealing with the average central station. With any present day central station negotiation, it is necessary, in the majority of cases, to "sell" the prospect. Competition in many cases is real, either in the form of operating or proposed steam or gas driven plants or personal prejudice. The best and most satisfactory negotiations are possible when the central station representative approaches his prospect in an enlightened spirit of coöperation and service. The best and most satisfactory contracts are necessarily those negotiated in this spirit. Such customers are almost always entirely satisfied and stay sold without any great amount of attention on the part of the sales force.

The best policy and the one most generally followed by progressive central station organizations is to deal with the prospect in terms of his own plant, eliminating so far as possible, all technical details.

Most central stations have several schedules of rates, each applying to different conditions of size and usage. This enables ready classification of the particular prospect. The policy usually followed is, of course, to locate the classification of the particular prospect and offer him a schedule of rates based on the actual or estimated figures available. Where quotation is based on estimates, it is always subject to change on the receipt of more detailed and exact data. It is not designedly the intention of the central station to quote a rate that will be unfair and unjust.

In some cases, it may be, a proposition is submitted which is based on snap judgment or on incomplete information. Naturally both sides to the negotiation welcome any information that will seem to justify revision of the original proposition, and such a course is manifestly mutually fair and equitable. In no case within knowledge, has it been necessary to excuse a negotiated contract because "it was necessary to forestall the installation of a private plant." It is true that it is human nature to endeavor to sell a product for the best price obtainable, but this "best price" is based on other factors than the immediate sale. Future business and overhead cost of complaints, adjustments and billing are very considerable factors. In other words, "charge what the customer will pay" is a strong statement when speaking in general and not specific terms, and is not borne out by the facts.

Attitude of the Consulting Engineer

The attitude taken in the paper referred to is not a new one. A consulting engineer when called in by a client to pass on a proposition submitted by a central station, feels, in many cases, that he must raise objections and make changes, however superficial and meaningless, to justify consultation. This attitude often leads to endless complication and occasional bad feeling in negotiation and to delay in getting the particular project under way. It is not contended that the calling in of a third party is not helpful to all concerned, but it is contended that the spirit and knowledge with which this third party enters the conference may, and does in fact, have a large bearing on both the present and future success of the matter in hand.

On large propositions it is frequently desirable and beneficial to call in a consulting engineer, providing one is selected who is familiar with, and understands the use of electricity and has a clear conception of central station contracts. In other words, the engineer should be professionally and technically qualified to pass judgment and to make suggestions that are both constructive and helpful. Such conditions usually help to make plain points of a technical nature that may not be clearly understood by one who is not technically trained. Unfortunately, at times, the engineer is no better qualified to pass technical judgment on such matters than is the business man.

Mutually Satisfactory Contracts

In common with other reputable business concerns, the average central station is not given to quoting and charging the highest rates the traffic will bear. It is to the interest of the central station to negotiate mutually satisfactory and equitable contracts. Often it is necessary for the central station sales representative to act as consulting engineer for the prospect. He can assist in making a proper and suitable lay-out of the equipment and is thus enabled to base cost estimates on more accurate data than would otherwise be the case. When the central station representative is technically qualified to render this service to the prospect, the consulting engineer's fee is saved, either wholly or in part, and more intimate and personal relations making for better mutual appreciation and confidence are established.

Mr. Johnston's Interesting Illustration

The statement regarding the large concern which contemplated signing an electric power contract, but before doing so decided to call in a consulting engineer, is interesting. The engineer's investigation resulting in a saving of 32 per cent. in cost of power when operating under the proposition finally accepted, is, so far as a private plant is concerned, a "paper" figure.

Several instances could be cited of the fairness and correctness of central station estimates when converted into actual operating contracts. In one case a manufacturer had consistently opposed the use of central station service, because it was felt that no actual money saving could be effected, and because of the cost of adapting the existing plant to the use of the service. After many trials permission was finally granted to make a detailed investigation with a view to submitting a proposition. The proposition as finally accepted, after having in the meantime been passed on by a consulting engineer without alteration, including power cost estimates and motor lay-outs, resulted in a monthly saving equal to 50 per cent. of the former estimated electric power plant costs (no accurate and reliable costs being available) and in a material increase in production from the same manufacturing equipment. Without the use of electric motors operated by central station service, it would not have been possible for this plant to have met the severe demands of war-time contracts except at a prohibitively high expense and much loss of time.

The reason, of course, why the average large and well managed central station can sell electric power to industrial users at attractive prices is primarily because of higher over-all plant efficiency due to large units operating at high load factors and with high system diversity load factors. While it is true that the average private plant is located at the point of use, has no line losses, expensive transmission to maintain and no legal and commercial charges to pay, it is also true that the average private power plant does not receive the same care and technical supervision that is accorded the manufacturing equipment and receives no special attention from the management until something goes wrong. Consequently, no particular attention is given to the cost of electricity produced in the average private power plant so long as power is produced and the manufacturing equipment kept operating. There are the capital and overhead charges in the average private plant, of interest, depreciation, taxes, insurance and superintendence, as is the case with the large station.

In conclusion it would be interesting to know the connected load in horse power, the integrated kilowatt demand, the operating and 24-hour load factor, and the general character of the plants for which the rates are given in Tables 1 and 2 of Mr. Johnston's paper. To be of any value in making accurate comparisons of the several rates quoted this information should be included.

It should not be understood from the foregoing remarks that the employment of consulting engineers by industrial managers when negotiating electric power contracts with central stations is not favored. On the contrary, especially in the larger negotiations, such relations are of considerable use in facilitating negotiations, provided the engineer brings to the task an open mind, an intention of fair dealing and the professional knowledge that qualifies him for it.

A Fair Basis of Profit-Sharing

By George Kingdon Parsons

This article describes a unique plan of profit-sharing in industry through which an apportionment is made to those who create the profit whether managers, salesmen, clerks, mechanics or laborers. The purpose is to reward profitable productive effort and loyalty and to promote satisfaction and joy in work. It is written from the well-founded belief that no scheme of profit-sharing has yet proved successful.

Mr. George K. Parsons *has served in scores of industries and in every rank from apprentice to president. His technical education was obtained at Cornell, which conferred upon him the degree of mechanical and electrical engineer. For many years he has been in consulting and executive work in industry, and is founder of the G. K. Parsons Corporation, engineers and Business Counselors, which renders counsel on industrial and business problems. In addition he is an officer, administrator and advisor in several corporations and private enterprises. Perhaps his greatest success lies in his ability to understand men.*

WHAT is an employee worth to a business? He is paid according to various standards, generally for the time he spends, partially for what he does. Is there no basis whereby we can compare the value of a man with the value of a dollar?

Society recognizes property rights, likewise it recognizes that "the laborer is worthy of his hire." Modern civilization has evolved a problem of vast proportions, generally recognized as that of capital and labor. In order thoroughly to comprehend the meaning, let us look more closely at what constitutes *capital* and *labor*.

Capital—As Employed in Enterprise

Capital in this sense represents investment—the investment of wealth. This reduced to its elementary form means that invested capital represents invested previous labor, because wealth is the fruit of labor. If there were no labor there would be no resultant capital. Therefore, why is there this seeming great difference between capital and labor? Are they not one and the same thing?

To avert the impending open breach between labor and capital which will undoubtedly be hastened when wages have to be reduced, there is but one hope. That lies in mutual understanding of their interdependence and a common interest in the combined earnings of each. Piece rates, bonuses and premiums are partial solutions. Real profit sharing on a rational, non-paternal basis can be the only ultimate remedy.

This article describes a unique plan of Profit Sharing by which the apportionment is made to those who create the profit, whether managers, salesmen, clerks or laborers. It rewards profitable productivity and loyalty and promotes satisfaction. It is written in the belief that no established scheme of profit sharing has proven fully successful.

Money is not necessarily of intrinsic worth, but in the absolute it is merely a token representing labor. The farmer brings the products of the soil into market. For these he receives certain compensation in the form of money or credit. As he goes home, he tells his friends that he sold his hogs or his wheat for so much money. But, really, what did he sell? Hogs and wheat are essential products of the earth, the water and the air, but the farmer would never have had them to sell if he had not worked. So long as there are chemicals in the soil there is a potential value, but so long as this value is only potential there is no real useful wealth which can be utilized as capital. In a similar way the wealth which we are accustomed to think of as created by the mines, oil wells, fishing, railroads or any industry, is the fruit of labor.

A Simple Case—Timber Cutting

Let us take a simple case where the business is essentially that of drawing on nature's storehouse—timber cutting. If one man works alone, he can cut sufficient trees to provide for his own support, and that is about all. It is plain, therefore, that what he sells is only by convenience called lumber. He is in reality selling the product of his own toil. That in turn becomes capital and if he is able to save a certain amount each year, then in time he will be able to use the preserved accumulation of his labors as additional capital and thus increase the volume of his business, which he proceeds to do by hiring other men. This crude example is taken because it is real and fundamental. If our lumberman has no capital whatever, except enough to furnish him with clothes and axe, he has to work all the harder because he has to pay stumpage to the owner of the timber land. This stumpage is a return on capital, and indeed is a very simple example of the reward of capital. The timber owner could not have owned the timber had not he or someone else done work. The timber cutter can never have capital unless he works very hard and saves carefully, then if he is fortunate enough to accumulate capital, which is merely the fruit of his previous work or that of others, then he is able to buy the brain and brawn of those who are willing to work, at least temporarily; for the guarantee of enough to live on, or current wages. This relation of servitude remains more or less stable until the hired help becomes dissatisfied or desires to assume a risk. In the meantime the employer must have gained a small amount in addition to the wages he paid, or else he failed to make his capital—the accumulatioin of the savings of his own labor—earn for him.

I have taken these simple examples in the hope of making clear the fundamental unity of capital and labor. Capital is simply labor converted. It may be reverted into labor, or it may be used to purchase the fruits of some other labor, and at the hands of the entrepreneur be made to earn more or less for its use. This earning of capital has been given the name "interest," and with refinements of society there has grown up in various localities certain more or less recognized standards known as normal rates of interest. The capitalist of the above example, the lumberman, must receive a higher rate of return for the investment of the savings from his own previous efforts if he invests these savings in an insecure business, than he would if he were to put them into a savings bank or other secure channel. This extra return above the normal interest rate is the return for the investor or entrepreneur. It is the reward for the gamble, for the risk which is taken in placing wealth more or less at the disposal of others for the conduct of uncertain business enterprises. It is this last amount which clear thinking men consider as the profits of a business. If a business merely earns a normal interest rate, that is, earns for the invested capital no more than that capital can get if invested with a minimum risk, then the whole financial proposition is unattractive and capital will depart. But this super-return, or return for the risk, is the reward of enterprise.

Big business is not essentially different from the one-man example previously considered. In big business, the investment is the capital which has been created previously by other work, and there are many employees of various capabilities. There are also many kinds of materials which are represented in the buildings, machinery, materials of production, etc. All of these are one. They are either simply human labor or they are the product of human labor.

Just as capital is given a normal rate of return, so is labor. It has been paid what has been considered a normal rate, which rate is based largely upon the so-called labor market. This return to labor, instead of being called interest, is known as wages. However arrived at, wages vary from that amount which barely purchases the meagre necessities of life for the worker, up to amounts which make it possible for him to purchase even some luxuries and in frequent instances to lay by a small store against the "rainy day." How like the return to capital! Capital is granted, as we said, the normal rate of interest, but it also secures a super-return in proportion to the quality of the investment.

When the reward is small, then the investment is poor, or it is being poorly managed. When the return is large, then the investment is fortunate or it is being wisely administered. The great secret of wise administration, excepting in rare instances where profits are unusual, lies in the frequency with which capital can be turned over or used. In other words, it means doing business on a minimum amount of capital and making that capital work as hard as possible.

Turnover of Capital and Labor

The accomplishment of this result must require labor and intelligently directed work on the part of the management. But what happens when business is being pushed hard? What happens when capital is being turned over rapidly, when the return to capital is not only the normal interest rate but a super-amount which represents, as we said before, an extra return for its being employed in this non-giltedged investment? Here is the beginning of trouble. As soon as capital begins to turn over rapidly, dissatisfaction creeps into the ranks of the employees. It comes in like a pestilence; invisibly it creeps around among the workers. There is always someone to point out that the firm is making money, and making a lot of money, and very frequently this circumstance occurs just at the time when neighboring employers are clamoring for men. Then comes the test of good management, to try to keep labor satisfied. The results are variable, but generally the effect is a very considerable amount of so-called turnover of labor. Men leave, and others are hired to take their places. There are requests, threats and demands, having to do with various real or artificial grievances, but the net result is that many men leave and many more are hired to take their places, and when all of this is summed up it has proven a very expensive thing both to the capital invested in the business and to the employees who have thus been tempted or driven from job to job.

So we see that a large turnover of capital and large turnover of labor means diminishing return at least from the standpoint of capital. Let us bear this in mind, that whenever we begrudge satisfaction to the employee, it will cost us much more money if we turn around and hire someone else to take his place. This is true in all too many instances.

Wages and Investment

What is the basis of wages? There was a time when the employer took keen advantage of the exigencies of labor. He employed men, as he said to himself, in the "open market," paying them what they demanded, but no more. He satisfied his conscience by saying that he was paying as much as other employers, and that was all labor demanded. Frequently this attitude of mind went further, clear down to the conditions under which the workers labored, and the employer pacified his judgment again by the consoling thought that as long as he could keep his men "satisfied" he was doing the very best he could for the business.

But in addition to the evolution of the race there are, as a result of various causes, cycles of shorter duration in which business fluctuates and then the complacency of the employer is broken by the unrest of labor. Frequently and justly this is laid at the door of the agitator who lives by his wits; but let us recognize this one thing, that he could not accomplish anything by stirring up labor if conditions were such that labor was completely satisfied. Agitation would not be possible if labor bore such a relation to the business that it felt its interest was common with that of the employer.

If capital is invested in a busines and has been getting just a bare margin of interest and the owner of the capital sees an opening for investment which will give him, even temporarily, much larger returns, he is prone to take his money out of the low paying investment and place it where he can get the larger reward. Bankers and promoters agitate capital at such times much as labor is moved by its leaders and agitators when times are good. So capital and labor have gone not hand in hand but ever on the brink of parting on the first opportunity.

Groping Experiments

Among the first experiments to overcome the problem of labor turnover we find two classes which represent in elemental form the greatest efforts of today. It all came about with the recognition that a worker should be paid not for the time that he spent but for what he accomplished and what was gained as the result of his effort. This was the one underlying idea, poorly visioned though it was, which caused an employer first to offer to pay so much per unit of production; in other words, pay the worker for the articles he manufactured, for the units of accomplishment coming from his hand or brain. This appeared in numerous forms, one of the most notable being the early piece-work systems. The other class of experiment is found in such occupations as fishing, where the returns from the catch are apportioned so much for the ship, so much for the owner, so much for each of the crew. This is true profit-sharing and, in more or less the same form, continues to this day.

But our civilization has become more and more complex. To meet the requirements of our material existence, various mechanical geniuses have racked their brains to develop machines and so-called labor-saving devices. Their advent has added materially to the complexity of the problem of management.

As a result, we frequently see new outcroppings of the recognition of the necessity for adequately rewarding labor, to be sure ever in the hope that capital's reward will be increased accordingly. There came a time a few decades ago when there was a great clamor raised about various novel and clever systems for the payment of wages. All of these were based upon the output of the operator. They could not have had the *éclat* and following which they have enjoyed were they not approximately in accord with the demand of the times. So various forms of piece-rates, bonuses, premiums, etc., have been used.

In industrial plants where workers operate machines, it was thought that little could be expected because, so to speak, the machines drove the men, but careful study has made possible the education of the workers so that with adequate interest in the work, stimulated by a more suitable reward, enormous increases in output have resulted. The writer recalls an incident which occurred a few years ago under his direction where the output of certain machines was increased from 50 to 400 per cent. and the workmen were not as tired at the end of the day as they had formerly been. In one department of a manufacturing plant this method of study and analysis coupled with an increased reward to the men augmented the total profit to the company by over 400 per cent.

We have seen another outcropping of the recognition of the problem in the various forms of pensions, insurance funds, etc., which for a century or more have been offered to workers. Many employers have earnestly striven to work out some scheme on the basis of so-called "profit sharing," which would really satisfy labor and give to it its just reward, at the same time treating capital in a like manner.

A Century of Muddling

Investigation and analysis has been made by the Welfare Department of the National Civic Federation of more than two hundred plans of so-called "profit sharing." As the compiler says, many of these schemes are recognized failures; many others are considered successful by the employer, but little could be gained of the real view of the success of the efforts from the standpoint of the workers. It is well known that labor organizations and labor leaders are absolutely opposed to any form of profit sharing, and even differentiation between workers by payment for the amount of work done. The above report says, "This in turn involves consideration of the fear of organized labor that the employers' real interest in profit sharing lies in its alleged usefulness as a means to weaken and disrupt the trade unions, and that with this once accomplished the employing interests would be free to regulate wages and hours to suit themselves, with no effective equality of bargaining power left in the hands of the workers."

These so-called profit sharing plans vary from the crude methods of giving a Christmas turkey to such schemes as that adopted by the great steel corporation which at various times has made it possible for its employees to buy its stock at fixed prices on easy payment plans. These prices were planned to protect the employee against ordinary fluctuations in the market price of the stock. Undoubtedly these means have served their ends in varying degrees. The first is plainly a gratuity and the latter is little better than if some local bank had been able to force the employees to deposit a certain amount of wages against the purchase price of securities of the employing corporation—just like the partial payment plan for buying securities of a broker. Of course, it had the one presumed advantage of conveying to the workers the avowed interest which the corporation through its officials held in their welfare.

Betterment and Paternalism

Industrial welfare led off the other way from the annual turkey at Christmas time to such gratuities as hospital and medical services and coöperative stores from which employees purchase supplies at prices presumably below the market. These are provisions for social life, including such organizations as baseball clubs, libraries, social clubs, etc., also such more promising schemes as that in vogue in the Cincinnati coöperative plan of engineering education.

This way of meeting the problem has to its very great credit the recognition of the fact that as the twig is bent so the tree will be inclined. By taking a vital hold on the training of the students and administering this training as wisely as seems humanly possible at the present time, the employers are insuring that these young men will find in later life that they have learned a trade and have received a good technical training. This step is undoubtedly one in advance and well deserves the attention of manufacturers and educators in other industrial centres.

Paternalism Doomed

But the moment that any of these betterment schemes begins to smack of paternalism, its doom is marked. It may not come overwhelmingly, but come it will. If the employer makes it possible for the employee to better his own condition, then and only then are we on sure ground. All of the gratuitous or semi-gratuitous schemes whereby the employee gets something for less than the market price cannot succeed in the long run. This is the handwriting on the wall. It has been proven over and over again. Altruism cannot stand on its own legs. The moment a man, however gifted, forgets the fundamentals of human nature, thus removing himself from the beneficent influence of the spirit, psychology and personality of the rank and file, that moment he is lost.

The real fundamental reason for the failure of the majority of the schemes for so-called betterment is that the moment we remove from the individual the responsibility for his own future, that moment we have taken from him the incentive, the mainspring of life. If in any wise a man's future is guaranteed through pension, insurance or any other form of more or less gratuitous paternalism, that moment his ambition is stultified. If he be an extremely strong man, then his energy will find some means of expression, but nevertheless he is not the useful member of society or industrial community that he would be had he been conscious of having honestly earned that which will guarantee him competence, comfort and social life. Self respect is the one supreme thing in every man's life.

Unity of Interest Vital

We now come back to our original problem, that of labor and capital, with perhaps a clearer vision. It is apparent that we are constantly evolving and there is no permanent settlement of any question. The best we can do is to challenge every proposal with the premise that no social problem can be solved or adequately met unless it satisfies the best and primary instincts of the human animal.

It is not worth while to dabble with any means of rewarding labor which can possibly raise a question as to the motive. A great many of the schemes of profit sharing which have been the product of good intention have failed because suspicion was aroused on the part of the workers regarding the motive back of the scheme. This must be avoided. Therefore, the relation between capital and labor on which is dependent the return of both must be, so to speak, on a running basis. Their interests must be common. If this is established and assured, then all of the other requirements are satisfied. If commonness of interest is recognized, then the requirements justice, fairness and confidence do not have to be considered because all of them are included and satisfied. It seems, therefore, that the only true solution to our great economic problem is to establish the oneness of interest of employer and employee, of capital and labor. This cannot be a half-way matter. It must not be dependent upon a certain regime of management of a corporation.

The worker meets his problem not only from contact with the corporation but from the fact that it is not practically possible for him to learn more than one trade. For this reason he is permanently tied to the trade, and by the same token, since the trade is permananently tied to the industry and the industry is permanently tied to the capital, so he is tied to the capital, and capital cannot get along without him. Then why differentiate between labor and capital? Why not talk only of industry?

Elements of Industry as a Unit

Why do we not think of industry as an economic factor—a unit? It represents dollars and workers, but the dollars are not doing anything without the workers and the workers cannot do anything without the dollars, which to the workers represent food, clothing and shelter. In that respect, the dollars are simply employed as they are in the boiler room to buy coal and oil to keep the machines running, and so dollars are necessary to keep the human machine running. In operating the industry, the difference between the expense for the period, say the year, and the amount of sales for the year, with due provision for the amount of capital involved in the various reserve accounts, represents the earning of the industry.

If the industry has paid to its workers enough to meet reasonable standards of living, and if it now pays to capital a reasonable interest rate purely for the use of capital, would it not seem correct if we recognized that since labor and capital have oneness of purpose through the industry, the net results after paying for the use of money's time and the use of men's time should be divided between the two on some fair basis? The word "fair" is, of course, very general, but that is the fault of our language, not of the mind, because all of us know what we term "fair."

If the capital and the executives and the workmen have been paid a minimum standard amount for the service which they have devoted to the industry, then if there is anything left over from the profits which is not necessary to provide against the future contingencies, is it not logical that this be apportioned to the capital and to the management and the labor in such a way that capital and the executives and the workers shall be rewarded for the risk that each has taken—capital for diverting its power from gilt-edged investments, and executives and workmen for the risk each has taken and the special effort and experience each has devoted to the industry? Do not consider this a theory. We are merely trying to cast light on a dark problem.

Business Must Pay Its Way

If at the end of the year the books show that a business has not prospered, one cannot go back and demand that each employee rebate a certain amount of his wages, but capital has to stand the loss. Then comes a period of readjustment, a dropping of an employee here and there "to reduce the payroll." The result of this is familiar to all of us—dissatisfaction and trouble all along the line. To prevent this, is it not just and logical to charge into the cost of doing business the minimum price which money demands for its use? In the cost of goods you do not hesitate to charge the material and the wages and the various indirect expenses and reserves of the business. Why is it not logical to charge for the use of the money whose service is devoted to the business? This will give a true total cost, and if the price for which the goods sell is exactly equal to this then the vendors of the raw materials, and labor and capital each will have received his price. If this earning is impossible then the management is wrong or the business has no claim for existence.

But suppose the business prospers; then all of the margin between the cost and the selling price represents a real profit. Let us suppose that a business is operated so that the costs are figured in this way and that the workers receive a minimum wage or drawing account, that is, their current wages, like interest on a bond, are sufficient for the standards of living.

Rewarding Effort

If this industry prospers and our premise is followed, then is it not logical that the profit should be allotted to the units producing that profit, namely, the capital and the labor? This is the concession which capital really does make in prosperous times when wages soar. We see numerous instances in the daily press of various industries having increased their wages 10, 20, 30 per cent. and even greater amounts in times of prosperity. On the other hand, when adversity prevails labor has to make its concession and receive only its minimum wage, in order to meet the conditions. This breeds trouble.

To clarify the question a little further, let us take for example a fair sample of a small business. Let us suppose it is honestly capitalized at $250,000, that the payroll, including not only wages but the salaries of officers and clerks, amounts to $125,000 per year, and the past history of the business shows that in prosperous years 10 per cent. dividends have been paid on the capital stock, or $25,000 per year, and in periods of depression this has dropped to 5 per cent. or $12,500. Remember that with this payroll of $125,000 the profits have run from $12,500 to $25,000.

On the New Basis

Now let us suppose we organize the business another way and pay wages and salaries representing the minimum amount to meet the living expenses of the employees. Let us at the same time assure labor, shop and office employees a fair share of the profits. In establishing what this should amount to, let us look at the psychology of the problem. Repeated experience proves that with the chance of increasing his earnings from 10 to 40 per cent., it is frequently possible for a worker vastly to increase his output, and this without tiring if the effort is properly directed.

Let us pay capital one-half of one per cent. monthly, at the same time that we pay our accounts payable and our officers' salaries. This represents the current use or interest on the money. It is entirely reasonable from experience that the profits of the concern would still amount to $25,000. This will be further enhanced by $25,000, making a total of $50,000 because the payroll can be reduced from $125,000 to $100,000, by elimination of the drones and by the introduction of efficient methods throughout the business.

Remember that every worker remaining with the firm has received his wages regularly and also that capital has been paid 6 per cent., or $15,000, for its use. There is no reason, no fairness or rationality about the arbitrary halving of the $50,000, and it is manifestly unfair for each officer and employee to receive exactly the same bonus or percentage on his wages unless those wages are perfectly set.

Capitalizing Brain and Brawn

The writer proposes the following method. It is a method of determining in as scientific a manner as possible the capital represented by each person in a trade or business. By this means the officers and employees in the above example can be rated or evaluated as individuals. Their combined worth to the business is what the writer terms the *human capital* invested in the business.

By this plan our problem works out thus:

Human Capital

Workmen	$384,000
Supervisors	36,000
Clerks	36,000
Sales force	72,000
Officers	72,000
Human capital total	$600,000
Financial capital	250,000
Combined capital	$850,000

The divisible earning described above is $50,000; $50,000 divided by 850,000 equals 0.0588. So the dividend or super-return is 5.88 per cent. With financial capital's previous 6 per cent. this makes a total of nearly 12 per cent. against the old maximum of 10 per cent. To the human capital represented by officers and employees this 5.88 per cent. on the rated capitalization of each means a big satisfying reward. Remembering that this capitalization is not wages, this dividend amounts to 35.28 per cent. of the established wage or drawing account.

This may seem an extreme case, but if we suppose the divisible profits were to shrink from $50,000 to $25,000, capital's bonus would still be 2.94 per cent., or a total of 8.94 per cent., while the employee's 2.94 per cent. on his human capital would amount to 17.64 per cent. of his wages. Investigation and reflection shows that a similar plan might be applicable to almost any sort of gainful enterprise of whatever nature, whether it be a store, hotel, bank, printery or factory.

In addition to the above, if employees whenever possible are hired with as great care as one purchases machines or materials, if they are assigned to work to which by scientific analysis they are best suited, and then if they are taught how to secure the best results from their efforts, they will, with the above incentive, make possible still greater profits.

The scheme offers every opportunity for individual ambition as each man's capitalization is based on his worth to the business. At least part of the profits must be paid at frequent intervals, preferably monthly, while a part should be earned and payable only if the employee works continuously to the end of the year. The capitalization should reward continued service and thus result in a stability of the business which cannot be insured otherwise.

Neither capital nor labor can have ground for complaint because each is at least getting what it did before, and each stands in line to receive any additional return which may come as the result of efficient effort and profitable operation.

The plan cannot be called an exact science, nor has it been put into effect in exactly this form, but the problem of capital and labor is so pressing that the writer feels it his duty to contribute this information for the attention of those in authority.

Draftsman-Machinists and Machinist-Draftsmen

By Robert Mawson

Partner, Mawson Brothers

TWENTY years ago—even up to ten years ago—the current thought of an engineer's career was for a young man to go into the drawing office and work his way up, and this beginning was considered an advancement in position over that of the young man who donned overalls and worked in the shop. The following out of this idea has resulted in book-draftsmen, paper-engineers and machine-machinists.

The men in the designing office come to know by theory only what certain things should do, and any appreciation of the unknown factors, even though they entered into manufacturing practice, was foreign to him.

On the other hand the designs which came into the shop were far too often worked upon in a haphazard manner, and the obvious result followed—impractical design for manufacturing and poor workmanship. During the past few years the engineering profession has learned and benefited from these mistakes and now happily we have both draftsmen-machinists and machinist-draftsmen.

The young man who starts working as a draftsman often advances into and through the shop, and as machinist, foreman, superintendent and works manager puts into practice the theories he employed when on the drafting board. Many of his early ideas change as he realizes that what often looks good on paper is far different when manufactured in metal. Theory becomes strengthened through practice. However, the knowledge acquired as draftsman is not lost.

Likewise many machinists who work on various machine tools, and have become proficient in their use, advance into the drawing office and become draftsmen. The knowledge obtained in wearing overalls is of the greatest of service to such men. Thus little puzzling things which worried each one of them in the shop work are now avoided as he designs machines for the other fellow to build. Inaccessible corners which required a special tool to finish are avoided where possible; ribs which might interfere with easy tooling are changed to a simpler construction. Castings which might fracture owing to faulty proportions are remedied as their detailed designs come up for attention.

To sum up, the broad result of these processes of change is better machines, correctly designed and properly manufactured.

"That side will win that shall overwhelm the other with weight of machinery. This takes time, but it is sure.

"This is a war of the workshops. Finally, it is a test of constructive skill.

"Not only cannon but aircraft, railroads, engines, tanks, shells, and all manner of equipment count.

"And in such a contest it is the central powers of Europe against the world, particularly against the fecund strength of the United States, the most efficient and resourceful maker of machines in the world."—*Dr. Frank Crane.*

Employment and Labor Maintenance

A Special Department to Aid Employment Executives

The Factory Newspaper

By Robert Voorhees

THERE is one condition that is imperative in any industrial plant. That is the stability which depends, fundamentaly, on three things, money, material and men. If the plant finances are not sound it is a bad proposition in whatever aspect it is viewed. If the material is inferior no amount of clever selling talk will gain a permanent market. If the labor employed is inferior, everyone may be sure that sooner or later the investment will prove a failure.

The maintenance of the best labor conditions is the most delicate task in the organization. A slight deviation from standard may cause the loss of an immense amount of money. Consequently, the labor supervisor or manager should be a highly trained, diplomatic, far-seeing man. No mere clerk will do. An executive, a high-salaried man who has but the one job—labor—is essential. Even in a small plant, employing but few, the manager or some other high official should attend to the labor question.

Scope of the Labor Department

The labor department should have absolute charge of everything pertaining to the personal element. Thus it would include the welfare, safety and service divisions. Its main business would be, not hiring, but retaining, employees. The best mediums for this are those that instill a spirit of pride and contentment in the employees toward the organization. Perhaps the two most highly efficient are by-producs of the labor department, the committee and the factory newspaper.

The committee, composed of executives and employees, is today common in many factories. It convenes every so often for the consideration of ways and means of increasing production, cutting down overhead, improving conditions. For the most part such committees have accomplished little. Either the office has created them as a sop in a seeming spirit of coöperation with the workmen, or the workmen have not been able to appreciate the efforts. In harmony with a good labor department, however, aided by the factory bulletin or newspaper, this is no doubt of their efficacy.

If the true "spirit of the hive" is in a factory, a workman will feel homesick if he throws up his job and goes somewhere else, even though he does get higher wages. Mere money will never do such a thing. A workman is not a mercenary brute, though certain rather mercenary manufacturers seem to hold steadfastly to such an opinion. It is because of this, because delight and interest in his work adds so much to a workman's happiness and satisfaction, all of which means greater production, that the factory paper is so successful.

Field of the Factory Newspaper

It does not have to be a pretentious affair. But it must appear every so often and have a settled policy. It should be divided into four main sections: service, information, instruction and entertainment. It is unnecessary to go into any great detail as to how much stress is laid on any one of these sub-divisions, since no two factories are alike or have the same problems. There is one thing that must be emphatically practiced, however, on each and every page, that is, frankness. If an employee knows what he is working for, what the object of the company is, he will work so much the more earnestly. The policy of too many factories is silence on this point. To work without an object is deadening. To have a certain, definite goal is the greatest incentive to efficient, careful effort.

In these times, when skilled labor is so scarce and so independent, many a harassed manager is driven to educate what labor he can obtain. Articles and illustrations of each operation in turning out the product manufactured renders understanding more easy. Prizes for articles by employees, prizes for the most efficient departments, prizes for the most capable workmen, all these do much to aid.

Work of the Committee

The committee should go into the cost of living, rents, housing, wages. In this way it is so arranged that the employees, in a way, "pay themselves." There are no strikes and wages cannot be raised inordinately, as the margin of profit, to which the men are educated, always stands as a bar. All of this material should be published in the paper, written clearly and simply so that each man may know "which side his bread is buttered on" and act accordingly.

During the war patriotic articles are of undoubted value. The American Federation of Labor is backing the war to the last man. There is no more patriotic body of men to be found than the American wage-earners. The axiom that "hearts are more nearly alike than heads" applies here with double force. It may well be said that one cartoon, which appeared recently in a factory newspaper, representing a planer slowly and painfully slicing the armor from Kaiser Wilhelm under the efficient operation of an American mechanic, has aroused more enthusiasm in producing war orders in that factory than any amount of written exhortation in the columns beside it.

The New Foremanship

By Meyer Bloomfield

Partner, Bloomfield & Bloomfield

EVER since the publication by this magazine of the Foreman's number in June, 1917 (a pioneer topic by the way) many employers, foremen and executives have sought further information and suggestion on this important subject.

Obviously, the foreman is the main point of contact between management and men. A point of contact is a potential point of friction. Within recent years, especially since the United States entered the war, ideas which in the past have been impatiently rejected as visionary have assumed a new force and importance in the conception of management. One such idea is that of the fundamental partnership quality which a properly organized working force presents. Another is the place of foreman as upbuilders of men and interpreters of management spirit and policy.

Now to carry out such a conception of foremanship and relations with the men implies systematic thinking and effort. *Management is never stronger than its weakest foreman link.* How can we build up a foremanship spirit? Foremen conferences devoting time to study of industrial questions, as well as the technical problems connected with the special work of each one, are absolutely essential.

Such conferences succeed best when planned ahead intelligently. A program for six months, covering a special topic each month is desirable. Such topics as "Why do men leave?", "How to Promote Team Play," "What Are the Best Industrial Standards?", "How Has England Met Labor Questions During the War?", are profitable subjects. Speakers can be invited to tell of some special experience. There are plenty of good men to draw from who have something worth while to say. Eventually, the foremen themselves will be stimulated to read papers of their own.

Activities such as these will in time develop foremen into a professional body and will benefit the organization as a whole. It is surely a mistake to leave so vital a group out of the scheme of general progress which is taking place in the management world. Much power for good and constructive help resides in the foreman force. This power should be developed and utilized.

One sure step in bringing about closer understanding among the various units of a working organization is to train foremen to a new conception of their responsibility to the men under them. What is particularly encouraging in this connection is the fact that so many foremen are ready to grow and measure up to the modern ideas of what managers must know and do.

Labor-Saving Methods for Employment Offices

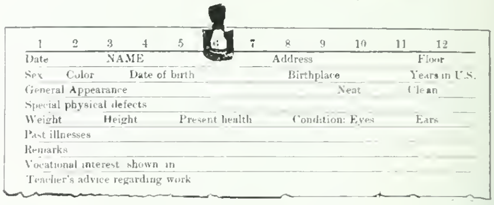
By Roy Willmarth Kelly

Director, Bureau of Vocational Guidance, Harvard University

ESTABLISHING a card record system for each employee by no means solves the problem of locating and collecting the data necessary in the work of the employment manager. In organizations carrying several thousand persons on the pay roll, it becomes an exceedingly laborious task to compile by ordinary methods any extensive figures concerning the length of employment, rates of pay, or reasons for leaving.

Ship yards, munition plants and other establishments engaged in government work have made enormous increases in their labor forces within the past few months, and many more employees must be added in the near future. On account of their methods of record keeping, ship yards employing from 3,000 to 10,000 men found it difficult to furnish certain employment facts recently requested by the Emergency Fleet Corporation. These figures were not numerous, but they were vitally necessary to the representatives of the Shipping Board who were trying to assist the yards in finding more employees. Time was an important element.

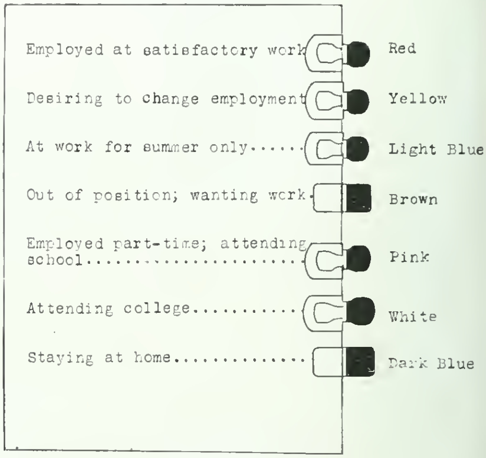
If bringing the worker into the plant ended the matter, the task of securing labor for the ship yards and munition plants would be relatively slight. There are undoubtedly plenty of workmen if they can be placed on the right jobs and kept in the organization. A few plants have commenced to deal with their large turnover in a comprehensive way, but much remains to be done in this field, particularly in the direction of es-



1 2 3 4 5 6 7 8 9 10 11 12

Date NAME Address Floor
Sex Color Date of birth Birthplace Years in U.S.
General Appearance Neat Clean
Special physical defects
Weight Height Present health Condition: Eyes Ears
Past illnesses
Remarks
Vocational interest shown in
Teacher's advice regarding work

FIG. 1. RECORD CARD—PLACEMENT BUREAU BOSTON CITY SCHOOLS



Employed at satisfactory work	Red
Desiring to change employment	Yellow
At work for summer only......	Light Blue
Out of position; wanting work	Brown
Employed part-time; attending school....................	Pink
Attending college...........	White
Staying at home..............	Dark Blue

FIG. 2. KEY TO FLAGS OF FIGURE 1

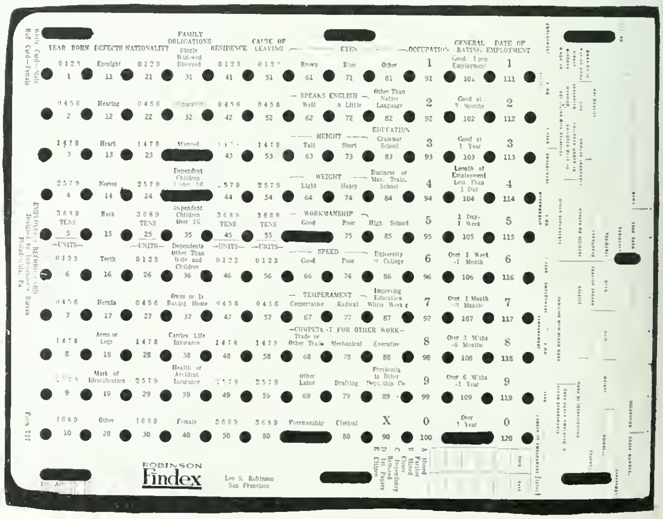

White Card—Male
Buff Card—Female
YEAR BORN
DEFECTS
NATIONALITY
FAMILY OBLIGATIONS
RESIDENCE
CAUSE OF LEAVING
EYES
OCCUPATION
GENERAL RATING
DATE OF EMPLOYMENT
Eyesight
Hearing
Heart
Nerves
Back
Teeth
Hernia
Arms or Legs
Mark of Identification
Other
Single Widowed Divorced
Married
Dependent Children Under 16
Dependent Children Over 16
Dependents Other Than Wife and Children
Owns or Is Buying Home
Carries Life Insurance
Health or Accident Insurance
Female
TENS
UNITS
Brown
Blue
Other
SPEAKS ENGLISH
Well
A Little
Other Than Native Language
HEIGHT
Tall
Short
WEIGHT
Light
Heavy
WORKMANSHIP
Good
Poor
SPEED
TEMPERAMENT
Conservative
Radical
COMPETENT FOR OTHER WORK
Other Trade
Mechanical
Executive
Other Labor
Drafting
Foremanship
Clerical
EDUCATION
Grammar School
Business or Man. Train. School
High School
University or College
Improving Education While Working
Previously in Other Dept. this Co.
Good Upon Employment
Good at 3 Months
Good at 1 Year
Length of Employment
Less Than 1 Day
1 Day-1 Week
Over 1 Week -1 Month
Over 1 Month -3 Months
Over 3 M'ths -6 Months
Over 6 M'ths -1 Year
Over 1 Year
EMPLOYEE'S RECORD CARD
Designed by Independence Bureau
Philadelphia, Pa.
Form 727
ROBINSON
Findex
Leo S. Robinson
San Francisco

FIG. 3. CARD FOR EMPLOYMENT DEPARTMENTS

tablishing really efficient methods of tabulating and interpreting statistics.

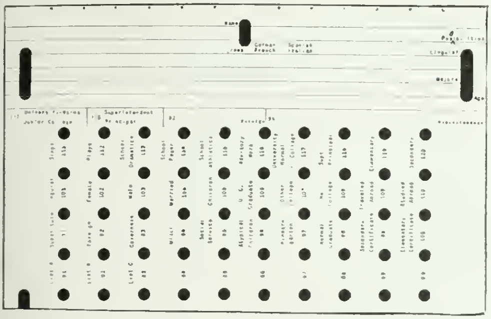

Name
German
French
Spanish
Italian
Major
Age
Foreign
Superintendent

FIG. 4. FINDEX CARD OF UNIVERSITY OF CALIFORNIA

It is to be expected, when men are being added to a plant at the rate of two or three hundred a day, that proper initial placements will not be practicable in every case. Valuable workmen apply who have come long distances to offer their services. If they are to be saved to the plant, how shall the employment department keep track of them, locate them quickly when emergencies arise, and promote them as they deserve? Entire reliance upon the foremen is undesirable. Dependence upon the usual filing systems means delegating the work to clerks and leaves numerous loopholes for errors and oversights.

FIG. 5. PHOTO—MECHANICALLY ANALYZING LABOR

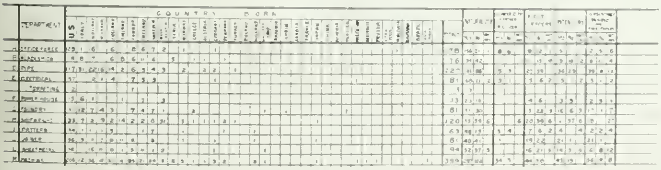

DEPARTMENT
COUNTRY BORN
U S

FIG. 6. SHIPYARD NATURALIZATION CHART

These are not new difficulties in management, but present conditions demand that they be met more intelligently than ever before. The effective use of our human resources demands not only better employment supervision, but more efficient methods within the employment department. It ought to be emphasized that this applies to purely private concerns, quite as much as to those interested directly in producing war materials.

ARRANGING FOR TRANSFERS

In every concern at least a few employees are transferred from one department to another, either permanently or temporarily. If a really stable working force is to be developed, and if output is to be kept at a maximum, this phase of employment management is likely to be developed to a much greater extent than has hitherto been considered possible.

A ship yard represents a highly complex type of organization from the point of view of transfers between departments. The building of a steel ship calls for some fifty distinct trades. There are a variety of shops engaged in the preparation of material: a pattern shop, a foundry, a joiner shop, machine shops, a steel mill, a paint shop, a pipe shop, sheet metal and coppersmithing shops, and numerous store rooms and warehouses. At work on the ship itself there are bolters, reamers, riveters, electricians, steamfitters, painters and carpenters, to mention only a few. Besides these, there are draftsmen and engineers, a large office staff and an army of semi-skilled workmen. In every department, there are men whose experience is such that they could be used in other parts of the plant during slack periods in their own division. For various reasons, temporary transfers of this kind are rarely made. Instead, when unpleasant weather makes it difficult for outside machinists or riveters to work, they are laid off. Their time is wasted and production is slackened. One of the serious obstacles to making such arrangements is to be found in the amount of clerical work and other red tape involved in making the transfer and in adjusting the pay roll.

Every large department store must plan for increases in the sales force on certain lines during the holiday season. Part of this can be done by transfers from other divisions of the store that for the time being are not relatively so important, or in which the demand for experienced salespeople is less.

A New York store employing about 2,000 persons makes out for each department, where extra demands are expected during the rush season, a list similar to that shown below. It contains the names of all employees who can be used for a few days in the department named on the card.

Department 24.			Domestic Undermuslins		
12	21	Murphy	17	08	Harrison
52	09	Keats	17	11	Jones

"O! Hell" or "Hello"

By James W. Wardrop

Employment Manager, Cadillac Motor Car Company

MANUFACTURING efficiency is economical production, based upon knowledge applied. Efficiency is the keyword of every successful business.

Its abuse does not rob it of its merit.

It is a development, not a finished thing.

Its power lies in its intelligent application, i. e. knowledge analyzed, classified and trained to produce known and profitable results.

Its principles may be applied with positive force to the bank president or to the boot black, and to all between. It has many elements and its greatest is the not always considered: the human element, *the man.*

Factory efficiency from this standpoint is the basis of the following remarks stated in shop language for a purpose.

The "First Man" failed to "stay put." Your tendency to this same failure relates you to the "First Man." The whole human element is so related.

To keep this element in the "stay-put" place is the first principle of efficiency, and volumes have been written on the "how" of this problem.

First. Locate, and "stay put" yourself. Study, educate, analyze, classify, know, develop yourself.

This knowledge applied is science. What you know and don't apply is like money buried in the ground. It don't grow, increase, or help anybody. It don't help you.

Application is multiplication. Multiplication is accumulation. Accumulation is wealth. The result is success.

The "opposites" produce failure.

Second. Know your business.

Third. Study, educate, analyze, classify, know, develop the other fellow.

The best investment of any company is to educate and develop its men, and to help them become efficient.

Abundant finances, the best machinery and tools and the best plans, are on the way to the "scrap heap" and "failure" in the hands of inefficient men.

Fortunes have been lost and futures ruined via this route.

One of the great twentieth-century problems in factory and shop is turn-over cost. This cost has to do with the human element—*the man.*

Some men shut their eyes to it, and, by not recognizing the fact, hope to escape the penalty of their folly. They remind one of the ostrich which buries its small head in the sand and imagines it is hidden from danger, evidently not having sense enough to know that it exposes its body as an easy prey.

Just so—some men hide their small heads in doubt and ignorance and imagine they are safe from danger, they thus expose their whole body and "business" an easy prey to everything that would destroy.

Better face the facts.

What is "labor turn-over cost"? It is the expense and waste of hiring and firing men.

Perhaps it has never occurred to you that there is any expense attached to this, except the small and necessary expense of maintaining a man at the gate to get "help."

Lots of people think this. This is not an intelligent "think." Close observers, and analytical minds, have classified the facts and state that the cost of "hiring and firing" a man in a large manufacturing plant ranges between $30 to $50 per man. This cost includes: (a) waste production, (b) instruction of new men, (c) overhead expense.

It looms up BIG! Think of hiring 24,000 men to maintain an organization of 10,000 men! On the basis of $50 per man this makes a total of $1,200,000 turn-over cost.

Can it be remedied?

Sure!

How?

Educate and develop the human element. Educate yourself. Educate the other fellow! Educate and develop both!

Some one has said that from the neck down a man is worth about two dollars per day, and that from the neck up his worth is unlimited. It is supposed to be a compliment to refer to a fellow as "on the job with both feet." What is needed today is a man on the job with both feet and his head! Mostly head!

In a company employing a large number of men, there will be a percentage of "men leaving," "men discharged," and, of course, "men hired" to fill their places. The expense of this is called "labor turn-over cost." A remedy to reduce this cost is the great need of the industrial world.

The intelligent coöperation of every man who has to do with skilled and unskilled labor is of great importance.

Owing to the war, thousands of men have left the shops under enlistment or draft, and thousands more will leave later. Because of government needs and contracts, certain lines of work, temporary and sometimes hazardous, offer wages higher than the prevailing rates of normal times. This has introduced a crisis in the labor field, and men are asking and expecting well established industries of permanence and good standing to meet the temporary high-wage-rate in permanent and assured positions. So it has come to pass that many semi-skilled and even skilled men are looking for unreasonable wage-rates for permanent positions, rates very much out of proportion with normal business.

This condition calls for higher efficiency; for men who can do things on a bigger and better scale; for men with ability to produce the maximum of results with the least waste of time, energy and money.

It is not always possible to employ men of sufficient development to be the most efficient. Here lies the problem. This problem is *men.*

The supply of men from the quantity standpoint is not involved in this case. Up to the present time there are plenty of men, but the supply of skilled and semi-skilled men is a large problem.

The employment department of a large company states that an average of 600 men apply for work daily; that the average requirement is about 125 daily.

In analyzing the 600 they find as follows: About 350 unskilled men who come from out of town; men who are "trying their fortunes" anywhere that promises a job. A large percentage of these have just two ambitions: 1. To get on the pay-roll. 2. To get off the pay-roll just as soon as a few dollars are due. They are called "floaters."

About 80 men are classed as semi-skilled: Men who have had short experience in shop-work, and are trying to pass from the semi-skilled to the skilled pay-rate by the short route of "changing shops" and changing from one city to another. These are called "prospectors."

About 170 are skilled men who have no trouble in getting a job. But the percentage of one-line men is large; men who want to do but one thing, viz: run a lathe, drill, milling machine, grinder, sand blast or welder, or work as a pipe fitter, polisher, wood worker, painter, solderer, etc.

The balance of the applicants are willing to take a job where their ability will fit and the rate of pay is satisfactory. As a whole they are fairly good men and from these we have to choose. They accept the job offered and hope to find their level later. As they enter the shop they find the surroundings strange and new.

The work is new. The faces are new. The rules are new. Even the city is new to most of them. The opportunity to get what they want is their first thought and study. They have few or no friends here. If married they probably think "back home." Therefore, first impressions count with these men—count hard! Here is where the efficiency of foremen and assistant foremen is needed.

It is within the power of the foremen to whom the man is sent by the employment department, and the assistant foreman to whom the man is turned over by the foreman, to impress the new man with confidence and courage, to receive and help him as to make a good.

steady workman for his department, or, on the other hand, to discourage and wilt his ambition and make the man a "floater."

The contact with foremen and assistants decides the efficiency of the foremen and the power of this contact means just one of three things:

1. Left.
2. Discharged.
3. Permanent good workman.

Left means dissatisfaction. Discharge means unsatisfactory service and bad record. Permanent means a well governed department and planned protection.

Low turn-over cost means: Better working conditions, better work, less scrap and less overhead expense, satisfied and efficient workmen.

The present turn-over cost of the factory in mind is high, expensive and alarming in view of labor conditions. The management looks to the department heads for a remedy. These department heads are capable. So use your head and measure up. Turn-over your brain and reduce turn-over cost. The human element needs human treatment and consideration. Take a square look at yourself in the mirror of analytical thought.

Are you an "O HELL! MAN?" or are you a "HELLO MAN?"

Does your own "human" say "O HELL!" to the new man?, or does it say "HELLO BILL, you'll do, we'll help you, you'll make good all right."

Does your assistant do the same?

There is no room for the "O HELL!" man today. The "HELLO" man has the opportunity of a lifetime—opportunity for himself, his department and his company.

Factory managers are aware of this. It is costing hundreds of thousands of dollars to cope with inefficiency and at the same time attempt to produce the market demand for product. The remedy is being worked out. Will the remedy "work me out?", that's the question. Am I "knocking down" new men faster than the employment department can "set them up?" with the result of: frequent changes of men, delay to work, poor work, much scrap, slow production, unnecessary expense, cumulative loss, disturbing the efficiency of other departments, unsatisfactory output, dissatisfied customers, unreasonable turn-over cost.

As a productive proposition a certain foreman recently remarked, "You can't pick castings off mulberry bushes." That is true. What is true of castings is more true of men. "You can't pick efficient men from foremen's requisitions." Both are the result of intelligent and efficient planning.

It is not always possible to produce a thoroughly qualified man on short notice, or to expect a new man to walk up to a machine and take hold with the familiarity, confidence and production of an employee who has been on the job for some time. It is wonderful what foreman efficiency is able to do with new men who are skilled in shop work.

That's how good men are "made."

That's how you were "made."

That's where efficient foremen shine.

There are lots of them. Get into the class.

Hiring and firing men every day or two will never improve the department. Don't blame a man who has ability if he wants to earn more; that's human. If he is able to earn more, help him to earn more. Satisfy the man and let him know that efficiency counts, and that the rewards of efficiency are mutual, i. e. both man and company profit.

This creates confidence. The man knows that you are interested in him. He is satisfied. He stays on the job. He becomes permanent. The turn-over cost is reduced. The department is benefited. That's efficiency!

It may be that the initial rate, or minimum rate is low, too low for a good man. Use your head! High and low wage-rates are placed as limits and properly so. This range is made to give full sway to a foreman's judgment. Go the limit of efficient judgment when a qualified man stands before you as an applicant.

If 30 cents per hour is the minimum rate, that's no reason why the minimum rate should be used every time, try somewhere else in the rate-range more in keeping with the ability of the man. Try to win A-1 men; men who are capable of developing efficiency. They are the cheapest in the long run and from every standpoint. Because a man has the power to discharge is no good reason for the expensive use of that power. That is forcefully true under war-time conditions. Letting good men out of a department, even of their own accord on due notice, is not good business policy, provided such men could be persuaded or induced to remain in the department.

Use your head! Call for the assistance of the manager if necessary to retain the best men. Thoughtfulness of the men is an investment that pays.

A few weeks ago a certain foreman asked for a "man." The employment man said: "I suppose you want a first-class man for that job?" He answered: "Yes, if I can get him, if not, give me the best you can and I'll make him first-class." That's the whole thing in a nut-shell!

It is within the power of an efficient foreman: To mold and develop the human element, to make it stay put, to make efficient workmen, to make men satisfied, to make the force permanent, to make the "shop reputation" a standing invitation to other skilled, efficient men.

The investment is BIG! The returns are large and sure, large and sure to the man and to the company. *That's efficiency.*

"I have traveled through the most diverse parts of the country and come in contact with every variety of our citizenship—the rich and the poor, those who have sprung from old English stock, as well as naturalized citizens who have come to us from the different lands of Europe, including the central powers. In the midst of all this diversity of place and people, behind all differences, I find a common and complete devotion to this country and an unquestioning devotion to the aims of freedom and democracy which are the purposes of this country behind the war.

"The ultimate sacrifice is made by those at the battle front, and readiness to make that sacrifice arouses the gratitude of the whole country. Those at the front must be supported by those at home in farm, field, mine, and factory.

"The whole Nation must dedicate itself, and as the issue between freedom and authority is clearly drawn I find evidences on all hands that the whole Nation is rising to its responsibility and dedicating all its resources, material as well as spiritual, to the successful prosecution of the war and to the realization of those ideals for which we have entered upon it."—*Hon. William B. Wilson,* Secretary of Labor.

"The people of the United States have at last awakened to national consciousness. Sectional lines, policies, and differences which in our previous history hindered and plagued us have forever disappeared. The past is behind us. Its animosities have been buried with it." —*Hon. Albert S. Burleson,* Postmaster General.

Editorials and Comment

Master Control of American Industries

THE work of war is so stupendous that the nation is only just beginning to realize its extent and to appreciate how everything and everybody is being affected. The American home has begun to feel the pinch of war shortage, first at the sugar bowl, second at the kitchen range and household furnace. We are warned of another pinch at the flour bucket and in meat.

The sugar, wheat and meat situation depends largely upon the production of these great staple foods. The fuel plight is somewhat different. There are ample supplies of coal in the United States and the problem is one of mining and transportation, with perhaps the greater emphasis on transportation. So fuel shortage is the first great indication reaching our people as a whole, that the business of war is far different from the business of peace, that the slogans used by superficial thinkers that war business is "business as usual" are untruths.

So far-reaching is the effect of this war that our Government is now engaged in a great manufacturing, or production, enterprise, which sooner or later must involve probably one-half of the effective adult population of the continental United States. If we send over seas an army of 5,000,000 men and have as reserve 1,000,000 more in the training camps of this country, we must, at a conservative estimate, have four adult persons—men or women—in productive pursuits to equip and supply each one of these soldiers in uniform. That is, for the 6,000,000 soldiers in the fighting army we must have 24,000,000 adults in agriculture and manufacture. These two sums total 30,000,000 persons. Discounting the young and the aged, the sick and infirm, the insane and the defectives, it is probable that these 30,000,000 persons will constitute at least one-half of all our population, that would be of any value whatever for the prosecution of the war.

How are we to obtain master control of the efforts of these millions of people who are engaged, or to be engaged, in manufacturing, of the production equipment that they operate, of the business organizations of the country?—in short, how are we to control the industry of the United States? This question is the most critical one facing the American people today. Tied up in it are all the problems of transportation, mining, shipbuilding, war industries, and the production of everything needed to care for our civilian population during the war.

The Congressional investigations into the operation of the Army and Navy Departments show that Congress is searching for the means to correct certain conditions, and if the sifting reaches the bottom Congress will come to the conclusion that in some way there must be a master control of American industry. Already this thought has found perhaps imperfect expression in a bill introduced into Congress to establish a Governmental Department of Munitions, and add to President Wilson's Cabinet a Secretary of Munitions. This general plan seems to be modeled after that of Great Britain. The master control that is needed is something far different from the mere stimulation of the industries of this country to produce. The bracing up of production was the great task set before Mr. Lloyd George when he became head of the British Ministry of Munitions. In some ways his appeal to the British people was a spiritual one. And we know in what a splendid fashion British industry responded to his pleas.

But our American problem is different.

The amount of war material that can be used by the United States during 1918 is dependent upon the number of available ships and their efficiency of operation. The problem of master control of American industry is to produce this amount of material, and only enough more to build up a reasonable surplus. Already there are signs that we are producing far faster than we can possibly ship. This condition of over-production may easily become a national menace.

Just consider:

If the maximum transportation outflow of a given industrial city is 100,000 tons per day, that city cannot with safety to itself or to the whole country, manufacture much more than 100,000 tons a day. If it exceeds that amount in a short time the factory shipping rooms will be congested and working people will be laid off. Similarly, if the ships leaving United States ports can carry only a certain amount per month (say 10,000,000 tons), then the country can safely manufacture for foreign shipment only 10,000,000 tons a month. That amount then becomes that particular industrial demand. If under these conditions the country manufactures, say, 20,000,000 tons per month for several months, industrial disaster will come. The result would be first to jam the wharves with freight, then the warehouses, then the railroad yards, then the main lines of the railroads, and finally the factory shipping rooms. Then manufacturing must cease. Labor must wait in idleness until the congestion is relieved. A host of idle working people in this country under existing war time conditions would be an internal menace greater than any external menace. The backing up of goods at the place of manufacture would bring about industrial collapse.

So the master control of industry that is needed is one that will prevent industrial disaster and a menacing politico-economic situation, by making sure that the Government does not procure more goods than can be shipped. The solution of this problem involves the complete organizing of American industry, both that part engaged in producing war materials and supplies and the other part turning out articles for civilian consumption. Once organized, all of this industry must be coördinated, so that its efforts will be directed to the production of those things needed by the Government in the quantities demanded by the needs of war—and no more—and beyond that for such civilian needs as are most pressing, for not all of the latter can be satisfied. This demands a form of control far different from anything that has been looked forward to in this country. It is most proper to ask for the way in which this form of master control might be set up. Fortunately, a suggestion is at hand based upon work already done.

The leading article in this issue of INDUSTRIAL MANAGEMENT deals with the organization and management of the Ordnance Bureau of the United States Army, and in particular with the Supply Division of that Bureau. Without doubt this is the most highly developed part of the United States Government having to do with the procurement and distribution of manufactured material. One mechanism employed is a form of record chart discovered and developed by Mr. H. L. Gantt. In a surprisingly compact space this chart can be used to show graphically the scheduled needs of any particular article for months in advance, the delivery of that article month by month, or week by week, as shipments are made on the manufacturing contracts, the shipment of this same article from the storehouses to the military units for which they are intended, or any similar data having to do with production. These charts supply the basic information needed to give managerial control, they are an invention of the greatest importance at this time, and great credit is due General Crozier for their adoption.

This proposal has been offered: *Plot all of the Government requirements for material of every kind on Gantt charts, together with the receipts of all this material. That is, bring under graphic analysis all of the facts in regard to the production of Government material necessary to give managerial control.* Do this for every department, bureau, division and section of the Government that procures material either through manufacture or purchase. Within each procuring unit, as for instance, Ordnance, Quartermasters, etc., develop a procuring committee presided over by a chairman. This man should be outside of the committee, that is, having no executive authority as regards detail production itself but should be attached to a clearing office charged with the duty of centralizing the production and progress charts of all the industrial work of the Government. The chairman of these various unit procurement committees would form an overall clearing committee to clear and handle the entire Governmental procurement program. This clearing committee would function so as to take up with all of the established federal agencies, as the Department of Labor, Fuel Administration, Railway Administration, etc., questions of priority, of accelerating or retarding production, schedules, transportation, labor, etc., and would have at its command at all times the most accurate obtainable data presented in compact graphical form.

The chairman of this clearing committee would be the Manager of Manufacturing for the United States.

It must be noted that this program contemplates building up information from where the needs are most accurately known and basing control only upon information.

A complete procurement program for the Government charted after this fashion would insure uniform progress of everything. The harassing, disaster-inviting condition of an excess of one article and a lack of another would not arise. If the amount of material procured should be compared with the shipping facilities and the proper control exercised, the disaster of overproduction, glut and unemployment would be avoided. If it were found that procurement was advancing at a rate much faster than it was possible to ship, the contemplated master control would lengthen the procuring program and so avert the disaster of congestion not only from our working people but from the Nation.

Industrial Management is glad to take this opportunity to back the principles of this plan.

Ordnance Bureau U. S. A.

IT was inevitable that Congress, representing the people of the United States, should investigate the War and Navy Departments and look into the preparations that have been made for raising our army and supplying it with everything needful to fight. It was inevitable, also, that a considerable part of the questioning and cross-questioning should deal with the situation in regard to rifles.

To the average American *the* fighting tool is the rifle. This idea that the principal small arm is *the* weapon in warfare, is the natural heritage of our frontier and pioneer life. Only a generation ago the rifle was as much a part of the household goods as the frying pan and the stewing kettle. Every one in the family—father, mother and all the sons and daughters—knew how to shoot and shoot to kill, although most of the killing was of game for the family table. Even today hundreds of thousands of American homes have on display a rifle as an heirloom, or more modern pieces used for sport.

So it was unavoidable that one of these days the American people should want to know about the production of rifles for the carrying on of war.

The vastness of the task before the Ordnance Bureau is outlined in the opening article on page 97. The immensity of the business that this unit of the government will handle this year is beyond any human realization. We can merely say that it will range between $3,500,000,000 and $4,000,000,000. But these figures mean nothing concretely to the human mind. They perhaps do little more than make us realize that we cannot drive to the country general store, load a two-horse wagon with ordnance supplies and pay for them out of the hip-pocket, cow-hide wallet.

A calm consideration of all the surrounding facts which include the hasty demand for equipment following mobilization, the procurement needs of the Army over a long period of time, the industrial capacity of the country, and the available shipping facilities, amply support the opinion that the Ordnance Bureau of the United States Army has done well. In the matter of rifles alone every soldier that has left for France has had a full personal equipment; within a very few weeks there will be such a surplus of these arms beyond immediate requirement, and production will be so rapid, that there is no reasonable possibility of any shortage throughout the duration of the war. What has been done with this article can be and will be done with all others. In fact, the statement, that within a few months ordnance material will be produced at a rate much greater than can possibly be shipped abroad, reflects the quality of the planning out and organizing of the Bureau's work.

Temporary shortages there have been, to be sure, but they are completely overshadowed by the achievement of creating a personnel of over 2000 engineers and industrial executives, and setting in motion the manufacturing machinery of the country to produce the greatest volume of business ever directed from any single organization.

In still another way the work of the Ordnance Bureau is an achievement of the first order. It has been so organized by those in charge that it combines much of the best of American industrial management practice. Thereby it stands as a model for other units of the government that have to do with the procurement and distribution of material. That this is being recognized as shown by the fact that other sections of the government having to do with purchasing and supply are drawing managerial advice and even men from the Ordnance Bureau to assist in working out their own problems.

It is very easy to pick out a detail that might be improved and argue therefrom that everything is rotten. What might an investigation reveal in regard to small points in your own business affairs, for instance? But the Bible gives us the final test of a man's work in these words: "By their fruits ye shall know them."

Technical Men Needed

The United States Civil Service Commission is endeavoring to relieve the dearth of ship draftsmen by recommending to the heads of colleges and technical schools that senior students in engineering courses be given intensive training in naval architecture during the coming spring, with a view to making them available for employment as ship draftsmen.

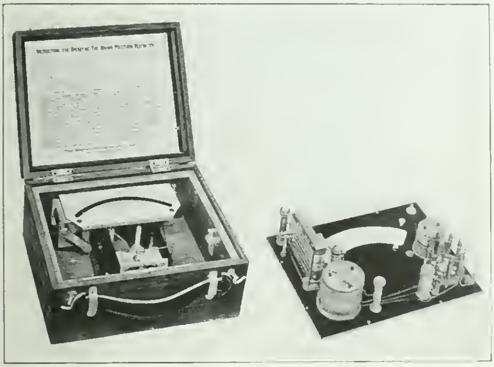
Factory Equipment News

The Latest Labor-Saving Machinery

Three Temperature Measuring Instruments

As a result of a great amount of study of the problem of automatic control of furnace temperatures the Brown Instrument Company of Philadelphia, Pennsylvania, has recently placed on the market three new instruments. One of these is called a precision heat meter.

Figure 1 is a complete view of this instrument and Figure 2 an interior view. Briefly its operation is as follows: With a standard millivoltmeter of high resistance an ordinary dry cell is supplied, about 1¼ inch in diameter by 2½ inch long, together with suitable rheostats to reduce the voltage of the dry cell from approximately 1½ volts to a range from 0 to 60 millivolts—the latter being the voltage range produced by the thermo-couples. In the first operation the voltage developed by the thermo-couple is opposed to the reduced voltage of the dry cell and when the pointer of the instrument stands at zero, it indicates that the voltages are equal. In the second operation the voltage of the thermo-couple is cut out and the voltage of the dry cell circuit read by direct deflection. This eliminates the line resistance entirely as in a potentiometer.



FIGS. 1 AND 2. BROWN INSTRUMENT COMPANY PYROMETER

We now have a deflection, indicating the actual temperature developed by the thermo-couple at the moment of reading the instrument. The fluctuation and the temperature of the thermo-couple will not be indicated, as we are reading the voltage from the dry cell.

In the third operation the thermo-couple is connected to the meter and the deflection read as explained above. By switching back and forth quickly the voltage from the thermo-couple circuit or from the dry cell circuit can be noted. If excessive line resistance has caused the indications of the milli-voltmeter to be lowered as compared with the dry cell circuit, a rheostat is adjusted to bring up the indications of the thermo-couple circuit to that shown by the voltage of the dry cell circuit. The instrument is now left connected to indicate from the thermo-couple circuit, and as the errors, if any, which may be due to line resistance, are eliminated the result is to indicate exactly correct temperatures.

The rheostat supplied has a capacity of 15 ohms which permits of line resistance equivalent to 15 ohms or a circuit of two copper wires almost a mile long. This construction is believed to have eliminated all but one possible source of error, that is changes in the actual indications of the meter due to sticking of the pointer, abuse of the instrument, spring fatigue, and the like. To guard against these factors the instrument can be supplied with a standard cell with suitable resistors so that the meter can be tested by the potentiometer method and can be checked. Where the instrument is supplied with a standard cell the temperature of the instrument should always be between 5 and 40° C. or 40 and 105° F. The standard cell will be injured if the temperature rises or falls beyond these limits.

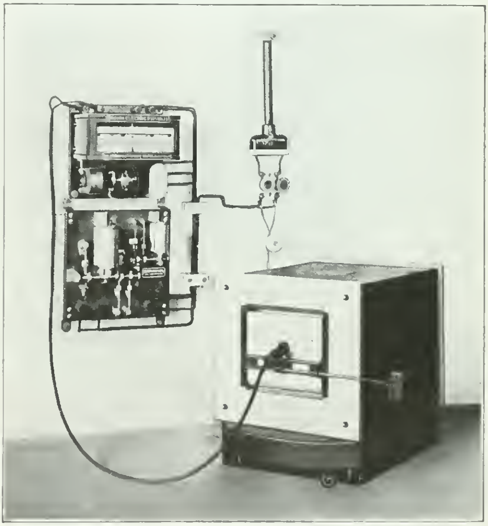


FIG. 3. BROWN AUTOMATIC CONTROL APPARATUS

From the above description it will be noted that the instrument with direct reading can be adjusted once a day to correct for line resistance or surrounding atmospheric conditions.

The furnace man uses it without any hand manipulation and the daily check or calibration can be put in the hands of an inspector.

Figure 3 shows an automatic control pyrometer attached to an electric furnace. It operates in the following manner: A thermo-couple formed of a nickel chromium alloy is installed in the furnace. This thermocouple actuates a high resistance millivoltmeter. Below the pointer and adjustable throughout the whole scale range, is a table carrying two contact pieces, separted by a thin piece of insulating material. A depressor arm driven by a small electric motor, or by a clock if preferred, depresses the pointer and in so doing the pointer forces together the two contact pieces below.

Let us assume that the pyrometer controller is required to hold the furnace temperature at 1400° F. The knob at the left of the instrument is turned until the index in front of the scale stands at 1400° F. This index corresponds to the position of the thin insulating material which separates the high and low contact. The switch connecting the furnace to the line is closed and the pointer slowly rises across the scale as the temperature of the furnace records. As the switch is already closed, when the pointer is depressed on the low contact, it continues to remain closed and no change occurs until the pointer passes over the neutral and is depressed on the high contact. The switch indirectly operated by a solenoid and relay is instantly actuated and the circuit opens. The temperature of the furnace begins to fall slowly and when the pointer is again depressed on the low contact, the circuit is again closed. This operation continues so long as the furnace is in use.

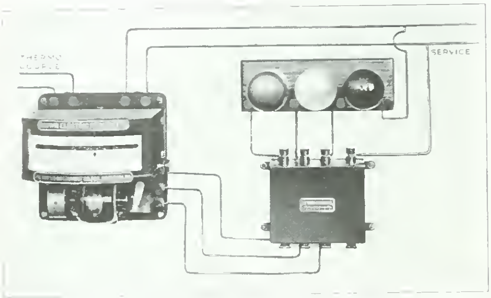


FIG. 4. AUTOMATIC VISUAL SIGNAL

The fluctuations are continuous and lie within the narrow limits of some 10 to 20° F. These continuous risings and fallings of temperature can be largely reduced and closer control can be procured by the use of two rheostats in the furnace line. The solenoid operated automatic switch is then used to simply cut in and out of circuit the second rheostat.

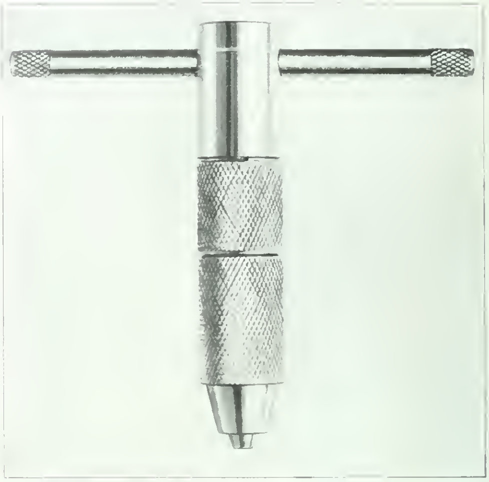
It will be realized that the same form of switch can be used to operate a valve to control a gas or oil furnace. It has been found desirable to use an automatic valve in a by-pass so as to simply control a portion of the gas or oil supply thus eliminating the maximum fluctuations caused by the complete opening and closing of the switch or valve.

In addition to an instrument to control automatically the temperatures of furnaces, there has been a demand for a device to signal automatically by lights whether the temperature is too high, too low, or correct in any particular furnace.

Figure 4 shows an instrument that has been developed by the Brown Instrument Company for this purpose. The same form of instrument is used as just described for the automatic control of temperatures, except that the pointer is depressed at intervals of ten seconds on to contacts corresponding to the red, white and green lights. The lamps themselves may be ordinary incandescent lamps of from 110 or 220 volts, either a. c. or d. c. The current which lights the lamps does not flow through the instrument but the lighting circuit is made and broken by an auxiliary device. A high resistor is in series with the circuit which reduces the current flowing through the contactors within the instrument, to less than 0.07 ampere. This prevents sparking and errors due to heating effects.

Ratchet Tap Wrench

THE accompanying illustration shows a ratchet tap wrench made in two sizes: No. 1 for taps up to ¼ inch, No. 2 for taps from ¼ to ½ inch. The pin of the T-handle is made to slide permitting the use of the tool in close places and difficult corners. For straightaway tapping this pin may be held in the center of the shank by means of a dog which fits against a milled flat surface. Adjustment is made immediately to either the right or the left by simply turning a knurled sleeve.

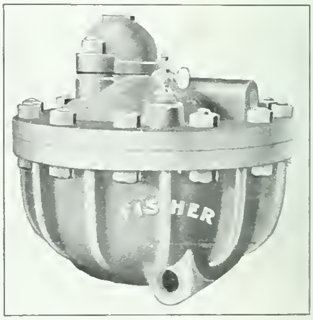


MOSS-OCHS CO. RATCHET TAP WRENCH

This tool has recently been put on the market by the Moss-Ochs Company, Cleveland, Ohio.

The Fisher Steam Trap

THE body of the trap illustrated is ribbed on the outside to provide strength and is cast without a core to insure uniform thickness of the walls. The inlet is at the side beneath the cover. As the condensate enters it is deflected by a baffle plate so that it will not disturb the operation of the trap bucket. The water accumulates in the pot or body of the trap and when it rises to the high water point overflows into the open bucket. The bucket is finally submerged and as it is lowered it opens the auxiliary valve and admits steam. The pressure in the trap is sufficient to discharge the water freely into the wide open valve until the water is lowered to the low water point. The valve then closes. Enough water is always retained to form a water seal and prevent the escape of steam.

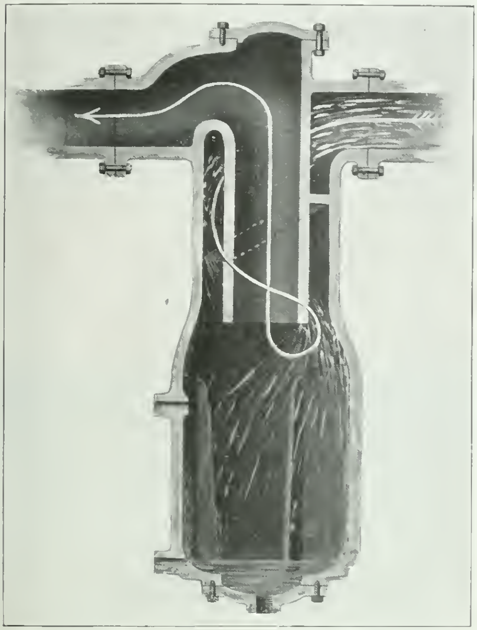


FISHER STEAM TRAP

This trap is made by the Fisher Governor Company, Marshalltown, Iowa.

Stratton Air Separator

THE Stratton air separator for the removal of water from compressed air is shown in the accompanying illustration. It is manufactured by the Griscom-Russell Company, New York City.



STRATTON AIR SEPARATOR

The operation of the separator is similar to that of the Stratton steam separator as centrifugal force is used to remove the water from the air. As the air and water enter the separator they are made to pass along a helical path formed about a central core. This path gives a whirling motion to the mixed fluids. As water is several hundred times heavier than air it is thrown against the wall of the separator leaving a reservoir of dry air in the central part of the apparatus. The water which is swung out of the curving current of air strikes the wall at an angle and flows along close to the wall until the receiver space is reached. Here the swirling motion is checked by baffles and the liquid is drained away.

"Wisconsin" Universal Grinder

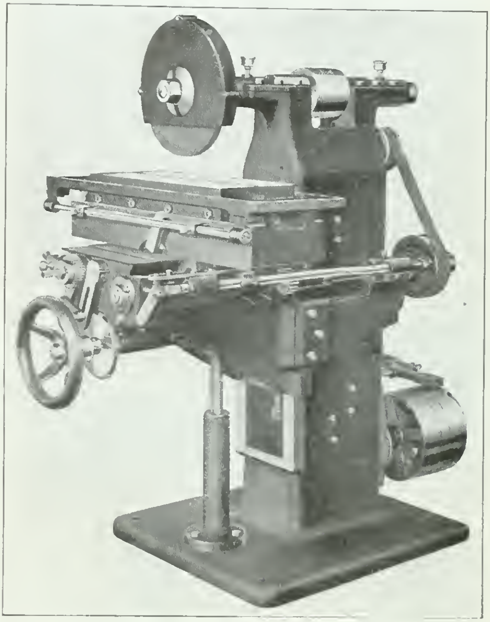
THE Wisconsin universal grinder has been designed to handle all kinds of tool and cutter grinding, as well as cylindrical, internal and surface grinding within the limits of its capacity.

The base of the machine is 24 inches square at the bottom, with a door at the back to give access to shelf space for the storage of tools and fixtures. The column is of a box section, carrying the vertical slide for the knee and supporting in a flange, as shown, the bronze nut for the knee elevating screw. Wheel spindle head is attached directly to upper end of the column.

The knee is of a box section entirely enclosed, except for the opening for the elevating screw. On one side is a tee slot carrying the stops for the cross feed. The saddle is substantially ribbed and fitted to the knee with a long bearing.

The table is supported on a sub-table giving a cylindrical bearing at the center and supporting pads at the ends. This table can swivel 90 degrees each way, and is graduated both in degrees at the center and for tapers per foot.

The spindle is of tool steel, running in bronze bearings, provided with a suitable takeup to compensate for wear. The head can swivel in either direction and is held in any desired position by means of a three-point clamp actuated by a single handle.



"WISCONSIN" UNIVERSAL GRINDER

The table surface is 5 inches wide by 36 inches long; the longitudinal table movement 20 inches; transverse table movement 8 inches; vertical table movement 9 inches; swing of centers 10 inches in diameter; the internal grinding attachment grinds holes 9/16 inch diameter and larger, by 4 inches deep.

This machine is manufactured by the Dauber-Kratsch Co., Oshkosh, Wisconsin.

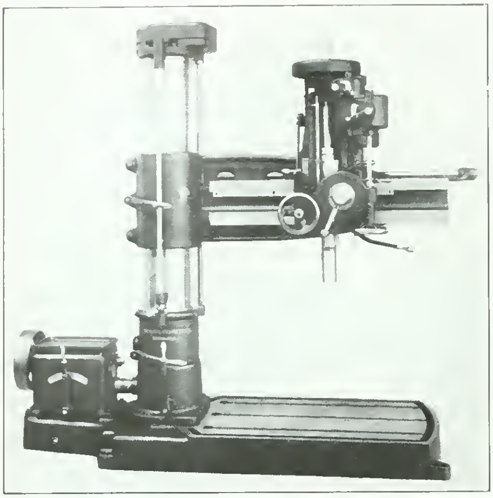
Morris Radial Drilling Machine

THE Morris Machine Tool Company, Cincinnati, Ohio, has placed on the market a four-foot and a four-and-a-half-foot plain radial drill with speed box drive. It can be arranged for cone pulley or constant speed motor in connection with the speed box or with a variable speed motor drive.

The design follows well standardized construction. The arm is moved up and down on the column by power with safety stops in the extreme positions. The column swings around a stump that runs clear to the top. At the top of the stump is a combination annular and thrust ballbearing which carries the entire weight of the columns and arm. A plain bearing for the column is provided at the bottom of the stump.

The base is deep and fully ribbed. Around its base is a lubricating channel which drains to a reservoir. An oil pump and piping can be attached if desired.

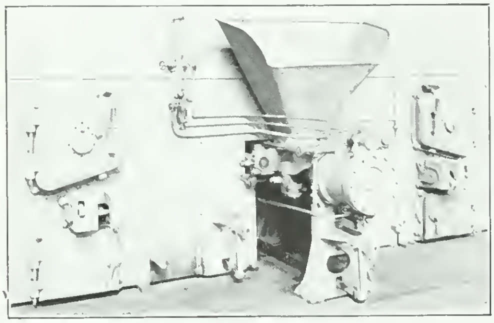
The reservoir at the bottom of the stump showing the vertical position controls the friction clutches on the pulley shaft of the speed box. This lever stops every gear in the machine and in connection with the double back gear lever on the head, the operator can secure six spindle speeds. With the speed box, eighteen spindle speeds are available, and on the cone pulley drive fifteen spindle speeds.


MORRIS RADIAL DRILLING MACHINE

Tapping attachment miter gears are mounted on back of the head enclosed in an oil-tight case. The back gear clutches and clash gears are made of nickel steel. The frictions are of the expanding ring type with adjustable rings. The spindle is equipped with a ball thrust bearing. The bearings throughout are of bronze with felt wipers, which have a recess which acts as an oil reservoir. Through the feed gear box mounted on the head six feeds are obtainable. A direct reading depth gage is provided arranged to throw out the feed when depth has been reached.

Roach Underfeed Stoker

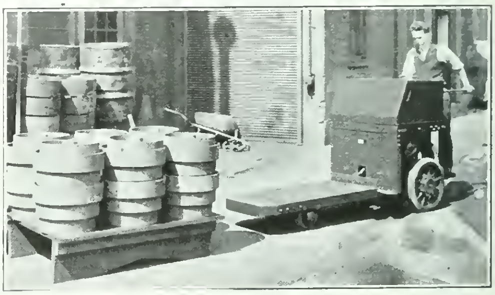
THE stoker illustrated herewith is known as the central underfeed type and has been developed to handle all grades of bituminous coal. It is manufactured by Joseph H. Roach & Company, Inc., Philadelphia, Penn., in sizes up to 600 horsepower using one retort only.


ROACH UNDERFEED STOKER

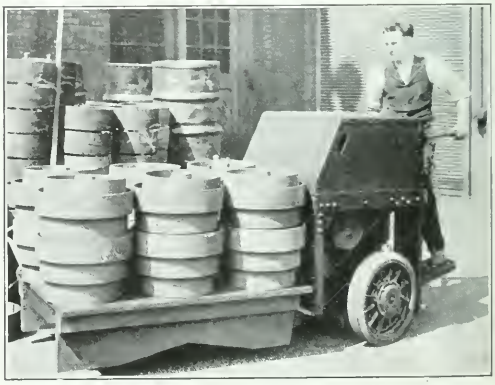
The design is such that much or little agitation of the fuel can be obtained as desired. The control is readily adjusted by the operator and the changes of agitation and distribution can be made in a very few seconds. The rapid coking of the coal as it enters the furnace is accomplished by a heavy air blast directed into the incoming coal so that the gases are distilled through the incandescent mass above. These controls are simple and easily accessible. A large floor space in front of the boiler gives access to the mechanism so that the firemen can reach, clean, inspect and repair the working parts without squeezing through or working into small openings. In case one or more boilers are cut off the line, a damper valve is provided as part of the equipment by which the air can be shut off in one of the boilers equipped to this stoker.

Self-Loading Electric Truck

THE latest model of electric lift trucks developed by the Elwell-Parker Company, of Cleveland, Ohio, is shown herewith. This type is built in two sizes.


TRUCK ABOUT TO PICK UP A LOAD

The truck is operated by two enclosed motors, one for propulsion and the other to drive the elevator. The storage battery is carried in the covered compartment closed to the controller and above the vertical propelling motor. This motor is directly splined to a single worm reduction on a four-pinion bevel differential. A contracting brake located between the motor and axle is spring operated when the driver releases his weight on one pedal forming half of the operating platform. This brake is capable of stopping the truck in its own length under its own speed.


ELWELL-PARKER TRUCK IN OPERATION

The drive axle is of the full floating type, and supports the truck frame on heavy springs. The drive shafts carry no weight and are removable. The drive wheels have 21½ x 3½-inch tires.

A lever adjustable for height steers all four wheels. The truck deck or platform is raised by the elevating motor which drives a worm lifting device. The lifting mechanism runs at slow speed in oil. A switch is closed manually to lift the truck platform after it has been driven beneath a separately loaded deck or platform. The lift is 4½ inches. When the load reaches its lower or upper limit of travel an attachment on the platform opens the motor switch.

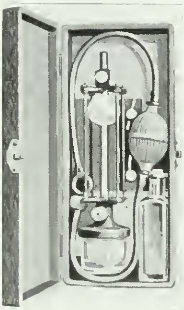
All parts of the truck are of steel and either lead or nickel-steel batteries are furnished sufficient to provide current for one day's work including travelling a distance of 10 to 20 miles. Two heights are built to suit different conditions. The higher one is provided with larger wheels and is particularly adapted for yard work.

Pocket Co_2 Indicator

A SMALL, pocket CO_2 indicator known as the American type is illustrated herewith. As shown it is complete with a rubber pump and reagent bottle fitted into a carrying case. It is provided with metal valves and metal supports. It is manufactured by Bacharach Industrial Instrument Company, Pittsburgh, Pennsylvania.

The instrument consists of a glass jar at the bottom to hold the analyzing fluid, connecting piece provided with a cock above it and glass measuring tube having a bulb at its lower end connected with the glass jar through the cock, and at its upper end connecting through another cock with a rubber bulb.

Its use is simple and a test takes only 2½ minutes to complete. It is claimed that from 17 to 20 analyses per hour can easily be made with this instrument.



POCKET CO_2 INDICATOR

Die Castings in Munitions
By Charles Pack*

THE situation that has existed for the past three years in the machine and tool industry has no been equaled in modern times. Lathes, milling machines and other standard machine-shop equipment can only be obtained at the most extravagant prices and then only on three to eight monhs' delivery.

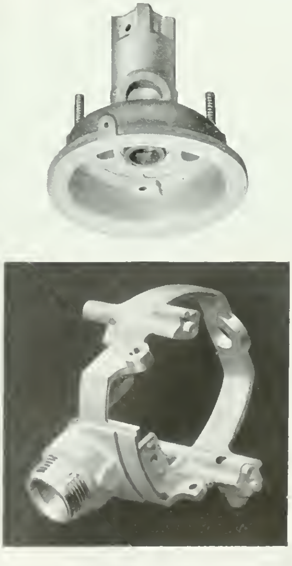
At the outbreak of the European War in 1914, the Allies swamped the American market with a series of gigantic contracts for shells, rifles, motor trucks, airplanes and other tools of modern warfare. These contracts were placed with a large number of American manufacturers, many of whom were not equipped for this class of work. Then began the mad scramble for equipment. Every available machine was gobbled up by munition manufacturers and the production of some of the standard makers of machine-shop equipment was bought up six months in advance, at abnormal prices.

With plans for the equipment and expedition of millions of troops, a large airplane fleet and a gigantic ship building program, the machine-shop equipment of the country was indeed taxed to the limit. The situation was further complicated by the necessity for carrying this program out with maximum speed and celerity.

The problem of supplying the number of skilled mechanics necessary to the successful operation of these machines was even more difficult. Machines can be built rapidly but good mechanics require years of training. It is a sad fact, but nevertheless true that this country has for a long time been dependent upon foreign countries for its main supply of skilled toolmakers. It is only necessary to look into any high class tool room to be impressed with the high percentage of foreign-born mechanics. There has been no difficulty in training men to operate certain special machines but such men require constant watching by skilled mechanics and in many instances are unable to set their own tools. An advertisement in the want columns of the daily papers will bring many screw machine operators, lathe hands, millers, shaper hands, etc., but high skilled, all around mechanics are as rare as the four leaf clover in the fields. The problem is by no means solved and deserves the serious consideration and coöperation of the manufacturers, the universities and the government.

ALUMINUM ALLOY DIE CASTING

Under conditions as outlined above, it is not surprising that any process or appliances that will tend to reduce the demand for high skilled machine labor should prove popular. This indeed is the mission of the die-casting process, and how well it has performed its mission, the writer will try to describe briefly in this paper.



DIE CASTINGS OF WHITE METAL

What Are Die Castings?

Die castings as understood in the trade are metal castings made by forcing molten metal, under pressure, into a metallic mould, known as the die. Castings so produced have a smooth surface, are extremely accurate, and require little or no machining. The accuracy that may be obtained depends largely on the type of alloy used. In general terms, it may be said that greater accuracy can be obtained with the low fusing alloys than with those having higher melting points.

Prior to 1914 all die castings were produced from zinc, tin or lead alloys. These alloys were comparatively weak and some rather soft. The die casting of aluminum alloys, the brasses and bronzes was the object of many experimenters. The three alloys mentioned, found only limited application in munition manufacture. Zinc and lead alloy die castings are used for fuse hole plugs on shrapnel shells, minor parts of rifle and hand grenades, etc.

ALUMINUM ALLOY CASTINGS

The aluminum alloy die casting is most extensively used in munitions. It is found in the vital parts of nearly every mechanical contrivance being used by this country and our allies in the prosecution of the war. Aluminum alloy die castings enter into the construction of machine guns, gas masks, wireless telegraph instruments, respiratory apparatus, aeroplanes, army trucks, field glasses, ambulances, and many other appliances too numerous to mention here.

In all cases the use of a die-cast part has resulted in a large saving of time and labor. In many instances the die-casting process has made possible what was otherwise apparently impossible. It may be well to cite one illustrative case.

Following the outbreak of the War, our War Department were confronted with the difficult task of equipping our regular army with modern appliances at very short notice. Foremost amongst these was the gas mask which in modern warfare is as much a part of a soldier's equipment as his gun. The War Department was confronted with the problem of turning out 30,000 gas masks in less than a month's time. As designed by the Army officers, one of the parts was to be made from sheet metal tubing and required a number of soldering operations. To get the required amount of tubing in so short a time was in itself a gigantic task, but to get a staff of expert solderers capable of soldering these parts in the time required was almost impossible. In desperation, the Army officers submitted the proposition for die casting. The part was redesigned to suit the die-casting process, the die constructed and the entire lot of parts were produced and delivered within the time specified.

An illustration of this part, made in aluminum alloy, is shown on page 157.

The die casting of brass and bronze has been the fond dream of die casting producers, but has never been achieved commercially. Just prior to the entry of this country into the War, the Doehler Die-Casting Company, Brooklyn, N. Y., developed the so-called Do-Di process for producing finished castings of brass and bronze. The large number of castings have been made by this process, particularly for Naval work.

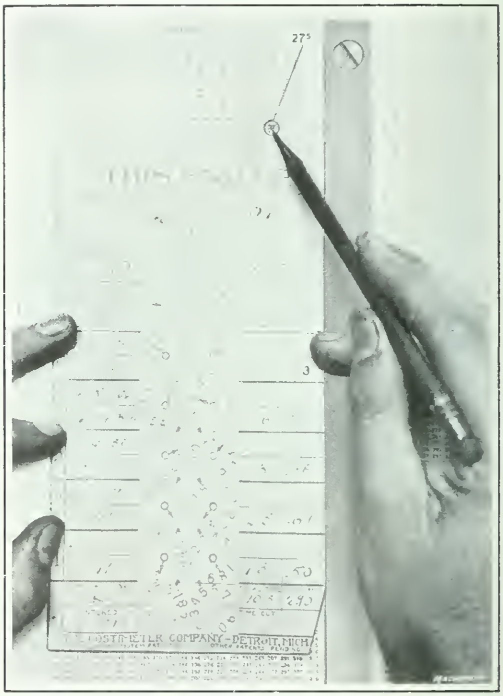
Some representative Do-Di Aluminum and white metal castings are illustrated on page 157.

"Alumunite"

A MODIFIED welding process for repairing broken aluminum parts has recently been developed in commercial form and is now on the market. "Alumunite" is an aluminum in flux that flows readily at a temperature of 350° F. In consistency it is in the nature of a paste rather than a free flowing liquid, cools quickly and therefore when being used heat must be continuously applied. A tensile strength of 8,500 to 12,500 pounds per square inch is claimed for it, and it is also declared to be free from the danger of disintegration. "Alumunite" is marketed by the Alumunite Manufacturing Company, Inc., New York City.

The "Costimeter"

AN elapsed time recording device that stamps the elapsed time directly on a card is being marketed under the name of the "Costimeter." When used with the "Costimeter" wage chart wage values are given corresponding with the elapsed time from one shop job to another.

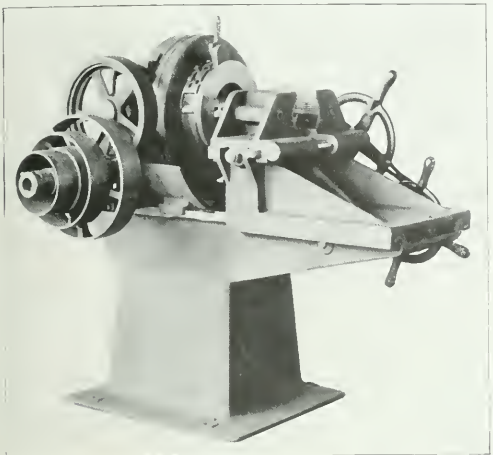


THE "COSTIMETER"

The operation of the instrument consists of placing a card in the slot and pressing the lever. The timing device may be arranged for any desired interval from one minute up, the customary length of interval is one-tenth of an hour or six minutes. Each instrument is provided with an eight-day clock, or can be arranged for electrical control from a master clock. The workman upon arriving at the factory in the morning inserts his daily card and presses the lever which records the time. Thereafter during the day he inserts the card again at the completion of each job. The right-hand lower corner of the card is cut off at an angle, which operates a safety lever and makes it impossible to enter the card except in the right way. Both card and wage chart must be designed for the firm using them. The time clerk reads the time taken from each job and determines its equivalent in money by placing the card on the wage chart and making a direct reading. This instrument is made by the Costimeter Company, Detroit, Mich.

Pipe-Threading Machine

THE Oster combination pipe-threading and cutting-off machine shown in the illustration is designated as No. 306-A, belt driven machine and has a capacity for threading pipe from 1¼ to 6 inches and bolts from ¾ to 2 inches. This machine is also built for direct motor drive.



COMBINATION PIPE THREADING AND CUTTING OFF MACHINE

In design it is of the open type with a self-centering vice. For threading close nipples, the machine may be equipped with two threaded nipple holders to be attached to the front of the regular vise jaws. The threaded end of the nipple is held in these holders while cutting the thread on the other end. When the thread is finished the die is released by one movement of the hand and a half turn of the vise hand-wheel releases the nipple.

By means of the quick die release it is possible to open the dies the instant the thread is finished. The machine may be adjusted to cut a certain length of the thread and will automatically repeat this operation without the attenion of the operator.

The cutting-off apparatus is operated automatically by means of a pawl attached to the frame of the machine.

The cutting oil is held in a reservoir is the base of the machine from which is is pumped to a smaller reservoir in the die-head. It is forced from this receptacle in a flood against all sides of the pipe that is being threaded. This machine is built by the Oster Manufacturing Company, Cleveland, Ohio.

"Master" 13-Inch Lathe

THE "Master" 13-inch lathe derives its name from the maker, The Master Machine Tool Company, New York City. It is intended for both tool room and manufacturing work. The general features of design follow those which are considered standard and need no special description.

The headstock is all-steel geared, with six changes of spindle speeds ranging from 28 to 418 r.p.m. Changes of speed are obtained by means of a lever and hand-wheel, shown on the front of the headstock itself. All of the gears are completely encased and run in oil.

The spindle is of 40 per cent. carbon steel and has a 11/16 inch diameter hole throughout arranged for draw-in collets. The spindle bearings are phosphor bronze.

The feeds are obtained through a 4-change feed box.

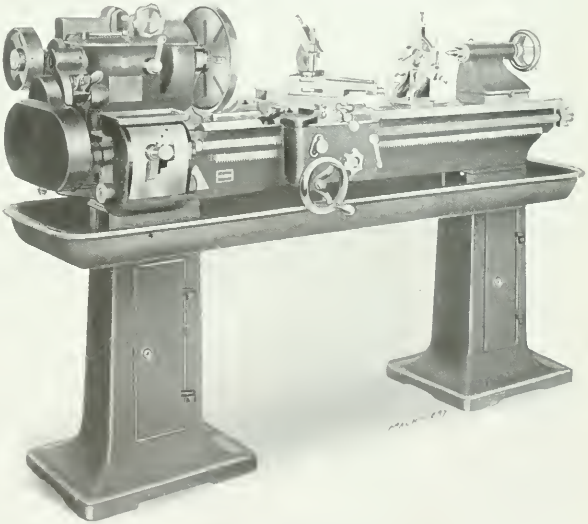
The lathe is regularly driven from the reversing countershaft through a single pulley, but motor drive is easily provided for if desired. The regular equipment consists of a countershaft, large and small face plates, fixed and steady rests, change gears and wrenches.

Number	Capacity in Inches
0	½ to 1
1	⅝ to 1¼
2	⅝ to 1¾
3	1¼ to 2¼
4	1¼ to 3¼
5	2 to 5
6	5 to 8

February Business Items

MR. RALPH C. DAVISON, for the past six years associated with the American Mason Safety Thread Company, has joined the selling staff of the American Abrasive Metals Company.

The Moline Automobile Company, makers of the Moline-Knight motor cars, and the Root & Van Dervoort Engineering Company, have been consolidated into the Root & Van Dervoort Engineering Company of East Moline, Illinois. The product of the combined plants will be automobiles, stationary engines, tractors and automobile motors and government supplies.



MASTER MACHINE TOOL COMPANY LATHE

"Industrial Housing Problems" is the title of a 31 page booklet just issued by the Aberthaw Construction Company, Boston, Mass. The author is Mr. Leslie H. Allen, who contributed an article to INDUSTRIAL MANAGEMENT on the same topic in our December issue. He presents the essentials of the problem of determining the style and building of houses for industrial workers.

EXPLANATORY NOTE—THE ENGINEERING INDEX

We find ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cents. A denotes a price of 40 cents; B, 60 cents; C, 80 cents; D, $1.00; E, $1.20; F, $1.60. The letter N indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

Serial publications are indexed on the appearance of the first installment.

CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of Industrial Management at 10 cents per month, or $1.00 a year; to non-subscribers, 25 cents per month, or $3.00 a year.

REFERENCE LIST OF PUBLICATIONS REGULARLY REVIEWED AND INDEXED

ARRANGED IN ORDER OF THEIR ABBREVIATIONS

A A Wkly	Aerial Age Weekly
AERA	AERA
Aeronts	Aeronautics
A I C E	Amer. Institute of Chemical Engineers
A I E E	Amer. Institute of Electrical Engineers
A I M E	Amer. Institute of Mining Engineers
A I Mt	Amer. Institute of Metals
Am Ec Rev	Amer. Economic Review
Am El-Chem Soc	Amer. Electro-Chemical Society
Am Fdymns Assn	Amer. Foundrymen's Association
Am Ir & Stl Inst	Amer. Iron & Steel Institute
Am Jl Pub Hlh	Amer. Journal of Public Health
Am Jl Sci	Amer. Journal of Science
Am Mach	Amer. Machinist
Am Rd Blds Assn	Amer. Road Builders' Association
Am Ry Bdge & Bldg Assn	Amer. Railway Bridge & Building Association
Am Soc Ht & Vt Engrs	Amer. Society of Heat. & Vent. Engrs.
Am Soc Mar Dftn	Amer. Society of Marine Draftsmen
Am Soc Nav Engrs	Amer. Society of Naval Engineers
Am Soc Ref Engrs	Amer. Society of Refrig. Engineers
Am Soc Tes Mat	Amer. Society of Testing Materials
Am Wd Pres Assn	Amer. Wood Preserv. Association
Am Wr Wks Assn	Amer. Water Works Association
A R E A	Amer. Railway Engineering Association
A R M M A	Amer. Raliway Mas. Mech. Assn.
Arch For	Architectural Forum
Arch Rec	Architectural Record
A S C E	Amer. Society of Civil Engineers
A S M E	Amer. Society of Mechanical Engineers
Assn Eng Soc	Association of Engineering Societies
Assn I S E E	Association of Iron & Steel Elec. Engrs.
Aus Min Stan	Australian Mining Standard
Auto	Automobile
Autocar	Autocar
Bkn Engs Cb	Brooklyn Engineers' Club
Bos Soc C E	Boston Society of Civil Engineers
Br Rds & Sts	Better Roads and Streets
Brs Wld	Brass World
Bt Fe & Stl Pt	Blast Furnace & Steel Plant
Can Engr	Canadian Engineer
Can Min Jl	Canadian Mining Journal
Can Soc C. E.	Canadian Society of Civil Engineers
Cas Eng Mthly	Cassier's Engineering Monthly
Cen Ry Cb	Central Railway Club
Chem Eng & Min Rev	Chemical Engineering and Mining Review
C E Soc St P	Civil Engineers Society of St. Paul
Cl Age	Coal Age
Colly Gdn	Colliery Guardian
Col Sl Min Mag	Colorado School of Mines Magazine
Col Univ Qly	Columbia University Quarterly
Com Air Mag	Compressed Air Magazine
Com Vhle	Commercial Vehicle
Comwh Engr	Commonwealth Engineer
Concte	Concrete
Contg	Contracting
Contr	Contractor
Corn C E	Cornell Civil Engineer
Cr Min West Aust	Chamber of Mines of West Australia
E Cb Balt	Engineers' Club of Baltimore
E Cb Phila	Engineers' Club of Philadelphia
E Cb St L	Engineers' Club of St. Louis
Econ Geol	Economic Geology
Eff Soc Jl	Efficiency Society Journal
Elec Jl	Electric Journal
Elec'n	Electrician
Elec Rev	Electrical Review
Elec Rev Chi	Electrical Review, Chicago
Elec Ry Jl	Electric Railway Journal
Elec Wld	Electrical World
Eng & Con	Engineering and Contracting
Eng & Min Jl	Engineering and Mining Journal
Eng Ed	Engineering Education
Eng News Rec	Engineering News-Record
Engng	Engineering
Engr	Engineer
Eng Rv	Engineering Review
Engr Soc Penn	Engineers Society of Pennsylvania
Fkn Inst Jl	Franklin Institute Journal
Flying	Flying
Fndry	Foundry
Gen Elec Rev	General Electric Review
Ht & Vtg Mag	Heating and Ventilating Magazine
Ice & Refrig	Ice & Refrigeration
Ill Eng Soc	Illuminating Engineering Society
Imp Inst Bul	Bulletin of the Imperial Institute
Ind Man	Industrial Management
InstAut Engrs	Institute of Automobile Engineers
Inst Rad Engrs	Institute of Radio Engineers
Inst San Engrs	Institute of Sanitary Engineers
Instn C E	Institution of Civil Engineers
Instn E E	Institution of Electrical Engineers
Instn E & S Scot	Inst. of Engrs. & Shpbldrs. of Scot.
Instn Mun & Cnty Engrs	Inst. of Munic. & County Engrs.
Instn Mech Engrs	Institution of Mechanical Engineers
Inst Met	Journal of the Institute of Metals
Instn Min Engrs	Institution of Mining Engineers
Instn Min & Met	Institution of Mining & Metallurgy
Int Mar Eng	International Marine Engineering
Iron Age	Iron Age
Ir & Cl Trds Rev	Iron & Coal Trades Review
Iron Trd Rev	Iron Trade Review
Jl Actcy	Journal of Accountancy
Jl Geol	Journal of Geology
Jl Ind & Eng Chem	Journal of Indust. & Eng. Chemistry
La Eng Soc	Louisiana Engineering Society
La Nat	La Nature
L S Min Inst	Lake Superior Mining Institute
Machy	Machinery
Manr Assn Engs	Manchester Assn. of Engineers
Mfrs Rec	Manufacturers' Record
Mar Eng & Nav Arch	Marine Engineer & Naval Architect
Mar Rev	Marine Review
Mas Boil Mkrs Assn	Master Boiler Makers' Association
M C B A	Master Car Builders' Association
Mech Eng	Mechanical Engineering
Mech Wld	Mechanical World
Met & Chem Eng	Metallurgical & Chemical Engineering
Min Mag	Mining Magazine
Min & Met Soc Am	Mining & Metallurgical Soc. of Amer.
Min & Sci Pr	Mining & Scientific Press
Mun Eng	Municipal Engineering
Mun Engrs Jl	Municipal Engineers' Journal
Mun Jl	Municipal Journal
Nat Assn Corp Schls	National Assn. of Corporation Schools
Nat Engr	National Engineer
Nat Lime Mfrs Assn	National Lime Manufacturers' Association
Nature	Nature
N E C Instn	N-E Coast Institution
N E Rd Cb	New England Railroad Club
N E Wr Wks Assn	New England Water Works Assn.
N Y Dept Labor	New York State Dept. of Labor
N Y Rd Cb	New York Railroad Club
Per-Way Instn	Permanent-Way Institution
Phil Jl Sci	Philippine Journal of Science
Power	Power
Pwr Pt Eng	Power Plant Engineering
Prof Mem	Professional Memoirs
Quarry	Quarry
Roy Un Ser Instn	Royal United Service Institution
Ry Age Gaz	Railway Age Gazette
Ry Cb Pitts	Railway Club of Pittsburgh
Ry Engr	Railway Engineer
Ry Gaz	Railway Gazette
Ry & Loco Eng	Railway & Locomotive Engineering
Ry Mech Engr	Railway Mechanical Engineer
Ry Rev	Railway Review
Ry Sig Engr	Railway Signal Engineer
S A E	Society of Automobile Engineers
Schl Min Qly	School of Mines Quarterly
Sfty Eng	Safety Engineering
Sib Jl Eng	Sibley Journal of Engineering
So Af Inst Engrs	South African Instn of Engineers
Soc Nav Arch & Mar Engr	Society of Naval Arch. & Mar. Engrs.
Soc Pro Sci Man	Soc. to Promote Sci. of Management
S & S W Ry Cb	Southern & Southwestern Railway Club
St L Ry Cb	St. Louis Railway Club
Stev Indic	Stevens Indicator
Stl & Iron	Steel & Iron
Surv'r	Surveyor & Municip. & County Engr.
Tel Engr	Telephone Engineer
Telephony	Telephony
Times Eng Supp	Times Engineering Supplement
Trnwy & Ry Wld	Tramway & Railway World
Univ Col Jl Eng	Univ. Colo. Journal of Engineering
Univ Ill	University of Illinois
Univ Kan	University of Kansas
Univ Minn	University of Minnesota
Univ Mo	University of Missouri
U S Bur Mines	U. S. Bureau of Mines
U S Bur Stds	U. S. Bureau of Standards
U S Dept Ag	U. S. Dept. of Agriculture
U S Geol Surv	U. S. Geological Survey
U S Nat Inst	U. S. Naval Institute
West Eng	Western Engineering
West Ry Cb	Western Railway Club
West Scot I & S Inst	West. Scotland Iron & Steel Inst.
West Soc Engrs	Western Society of Engineers
Wis Engr	Wisconsin Engineer
Worc Poly Inst Jl	Worcester Polytechnic Inst. Journal

The Engineering Index

The following pages form a *descriptive* index of the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world in the English, French, Dutch, Italian and Spanish languages, as far as possible on account of war. The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the charter and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us. See the Explanatory Note given on the opposite page, where also the full titles of the principal journals indexed are given. This list is subject to change from time to time.

NOTE.—The Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

DIVISIONS OF THE ENGINEERING INDEX

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INDUSTRIAL MANAGEMENT

EDUCATION

Apprenticeship

Apprenticeship Training Schemes (83071 A). 2200 w. Engng—Nov. 30, 1917. Reviews paper by A. P. Fleming to Instn. of Engrs. & Shipbuilders in Scotland, which gives an account of the work at British Westinghouse Co.'s Works.

Chemical Engineering

The School of Chemical Engineering Practice—A Year's Experience (82785 B). William H. Walker, with extracts from letters by members. 3000 w. Jl Ind & Eng Chem—Dec., 1917. Objects of the school.

Engineers

Engineers in Training (83000 A). Robert Tudor Hill. 2500 w. Met & Chem Eng—Dec. 15, 1917. Desirable changes in technical training.

The Education and Training of Engineers (83056 A). 1200 w. Elec Rev—Nov. 30, 1917. Serial, 1st part. Needed reforms.

Intensive Training

The Engineer, the Cripple and the New Education (82921 A). Frank B. Gilbreth and L. M. Gilbreth. 11 pp. A S M E—Dec., 1917. Progress report stating definitely the work the engineer should do to help the cripple to be independent of charity.

Mine Managers

Mine Managers' Examinations (83127 A). Ills. 3500 w. Colly Gdn—Dec. 7, 1917. Questions for certificates of competency.

Discussion of Mr. G L. Kerr's Paper on "The Higher Training of Colliery Managers" (83118 N). 30 pp. Instn Min Engrs, Trans—Nov., 1917.

Mining

Mining Education and Research (82815 A). William Pickup. Presidential address to Manchester Geol. and Min. Soc. 5000 w. Colly Gdn—Nov. 16, 1917. Particularly as applied to the county of Lancashire.

Power Plant

Power Plant Course at Wentworth (83193). Carroll H. Beers. Ills. 1500 w. Power—Dec. 25, 1917. Wentworth Institute's new course in steam and electrical power-plant practice.

Reform

Educational Reform—Its Relation to a Solution of the Industrial Deadlock (82978 N). C. V. Corless. 2500 w. Can Min Inst, Bul—Dec., 1917. Serial, 1st part Importance of the question; suggestions for desired training, etc.

Women

Women Engineer Students (82827 A). Ills. 3000 w. Engng—Nov. 9, 1917. Account of an engineering factory in Scotland for the exclusive employment of educated women.

FINANCE AND COSTS

Accounting

Cost Accounting for Oil Producers (83103). Clarence G. Smith. 116 pp. U S Bur Mines—Bul. 158. Descriptions and discussions of balance sheets, profit-and-loss statements and bookkeeping methods adapted to the oil business.

Appraisement

Reproduction Cost in Industrial Appraisement (83305 A). Charles W. McKay. 3000 w. Ind Man—Jan., 1918. Discusses seven appraisal questions and offers suggestions.

Canada

Canadian War Finance (82977 N). O. D. Skelton. 15 pp. Am Ec Rev—Dec., 1917. Reviews the course of war finance and considers topics related.

Costs

Expenses and Costs (82704 A) H. L. Gantt. 1000 w. A S M E, Jl—Dec., 1917. Discusses means of determining the cost of a manufactured article.

Depreciation

The Depreciation of Railroad Property (82870). G. C. Hand. 5000 w. Ry Age Gaz—Dec. 7, 1917. Exposition on value and depreciation, with suggestions.

Exports

Broader Field for Export Organizations (82988 A). G. A. Harris. 2000 w. Iron Age—Dec. 13, 1917. How demands of foreign buyers are to be met.

Investments

Equitable vs. Confiscatory Return on Investment Devoted to Public Use (83006) 3000 w. Ry Rev—Dec. 15, 1917. Message from Samuel Rea delivered at 11th annual meeting of the Ass'n of Life Ins. Presidents, in New York, Dec. 7, 1917.

Payment Systems

Premium Bonus System (82933 N). William H. Riddlesworth. 20 pp. Instn E & S Scot, Trans—Nov., 1917 Historical résume of existing systems; formulæ; diagrams and figures.

Price Fixing

Agreed Prices and Their Meaning to Foundrymen (82704). 1800 w. Fndry—Dec., 1917. Influence of labor on cost of castings Rates on old material. Meeting of manufacturers in New York.

Railroad Securities

Fair Play for Investors in Stocks and Bonds of American Railways (83181). James Speyer, in *N. Y. Sun.* 2200 w. Ry Rev—Dec. 22, 1917. The existing situation and the remedies.

Valuation

Railroad Views on the Valuation Act (83148). 8000 w. Ry Age Gaz—Dec. 21, 1917. Replies of roads to Dr. Prouty's memorandum.

War Revenue

The War Revenue Act of 1917 (82976 N). Roy G. Blakey. 24 pp. Am Ec Rev—Dec., 1917. Features of the bill are considered.

War Tax

Memorandum on War Excess Profits Tax (83036). 3500 w. Eng & Min Jl—Dec. 15, 1917. A protest pointing out the unjust and discriminatory effect of the statute.

MANAGEMENT

Coöperation

Getting Employees to Make Suggestions (83278). 1800 w. Elec Ry Jl—Dec. 29, 1917. Coöperation of men in solving problems on the Denver tramways.

Control System

Lodge and Shipley Control System (83289 A). D. M. Perrill. Third article of a serial. Ills. 3000 w. Ind Man—Jan., 1918. Importance and methods of inspection.

Industry

For Victory Through Industry (83284 A). William C. Redfield. 5000 w. Ind Man—Jan., 1918. The pressing need of coöperation in industry for the sake of production.

Labor

Labor-Turnover Records and the Labor Problem (82922 A). Richard B. Gregg. 6 pp. A S M E—Dec., 1917. Advocates the application of rational methods of analysis.

The Old Hand (83168 A). James Edgar. 1200 w. Mech Wld—Dec. 14, 1917. In defence of the employment of men over forty.

How to Get Help (83309 A). N. D. Hubbell. 1800 w. Ind Man—Jan., 1918. Suggests methods used with varying success.

Organization

Organization—A Material Planning Department (82983). C. A. Marston and J. Edward Schipper. Charts. 2000 w. Auto Ind—Dec. 13, 1917. Serial, 1st part. System successfully installed by Hupp, applicable to any large manufacturing organization.

Organization of the Western Electric Co. (82985 A). H. A. Halligan. From paper read before the Taylor Soc. 2000 w. Iron Age—Dec. 13, 1917. Ideal is highly developed functional management with adequate central control.

Planning

Planning Department in Modern Shops (82864 A). From an address before the Providence Eng. Soc. Cooper. 1700 w. Mech Wld—Nov. 23, 1917. Serial, 1st part. Routing, instruction, time and cost, discipline, etc.

Reports

Putting It Up to the President (83296 A). Lester Bernstein. 2000 w. Ind. Man—Jan., 1918. Faults of reports; purposes, arrangement, etc.

Strikes

A Saturnalia of Strikes (82811 N). 8000 w. Cham Mines W Aust, Mthly Jl—Aug. 31, 1917. Labor troubles in Australia.

Women Workers

Employment of Female Labor in the Foundry (82796). W. L. Churchill. 2000 w. Fndry—Dec., 1917. Making core-making an attractive occupation. Good working conditions essential.

The Employment of Women in Railroad Shops (82742). Ills. 1500 w. Ry Age Gaz—Nov. 30, 1917. Results at some of the shops.

The Woman in Railroad Work (83011 A). Stuart Bready. Ills. 25 pp. N. Y Rd Cb—Nov. 16, 1917. Work which may be performed by female labor.

See also Factories, under MECHANICAL ENGINEERING, *Machine Works and Foundries.*

REGULATION

Business

The Business Machine at Washington (83297 A). Howard E. Coffin. 4000 w. Ind Man—Jan., 1918. War organization of the Government to direct industrial policy and to deal with labor.

Contracts

A Fair Royalty Contract for Employees (83052). Robert G. Pilkington. 2500 w. Am Mach—Dec. 13, 1917. Possible way of increasing income. Suggestions.

Control

Bringing Capital and Labor Together (83292 A). J. P. Brophy. 1200 w. Ind Man—Jan., 1918. Suggests a board of control to determine hours of labor, wages, etc.

Department of Labor

What the Department of Labor is Doing to Win the War (83297 A). Louis F. Post. 3500 w. Ind Man—Jan., 1918. How the Department is endeavoring to fulfill the requirements of employers in various kinds of war work all over the United States.

Employment

Employment Manager and Foreman (83306 A). Roy W. Kelly. 1200 w. Ind Man—Jan., 1918. Relationship; foremen's duties and responsibilities.

The Course of Employment in New York State from 1904 to 1916 (83009 N). 50 pp. N Y Dept Labor, No. 85—July, 1917. Study of the general problems of unemployment.

Labor

Adjustment of Labor to War Needs (82863 A). 1800 w. Iron Age—Dec. 6, 1917. New Bureau, organized by Council of National Defense.

Dilution of Skilled Labor, and Women in Industries (82713). G. H. Baillie. 2000 w. Am Mach—Nov. 29, 1917. How Great Britain is meeting various labor problems.

Union Scale of Wages and Hours of Labor, May 15, 1916 (83008 N). 287 pp. U S Dept Labors Bul 214—Sept., 1917. Reports higher wages than any previous year.

Labor Legislation

Decisions of Courts Affecting Labor: 1916 (82888 A). Lindley D. Clark and Augustus P. Norton. 335 pp. U S Dept Labor—Sept., 1917. Review, text and summaries of decisions.

Labor Problems

Fostering the Shop Spirit (82733 A). W. E. Freeland. Ills. 2500 w. Iron Age—Nov. 29, 1917. Helpful movements for the development of employee and community interest.

Organization

The Importance of Organization Laws in This World Crisis (83285 A). C. E. Knoeppel. 700 w. Ind Man—Jan., 1918. A plea for the study of principles and laws.

Power

Mastering Power Production (83290 A). Walter N. Polakov. 3000 w. Ind Man—Jan., 1918. Serial, 1st part. Development of the principle of producing for the common good.

WELFARE AND SAFETY

Accident Prevention

Accident Prevention in the Textile Industry (82926 A). David S. Beyer. Illus. 18 pp. A S M E—Dec., 1917. Guards and other safety appliances.

Securing and Sustaining the Coöperation of Trainmen in Accident Prevention Work (83241 A). H. A. Nicholl. 3000 w. Sfty Eng—Dec., 1917. Suggests methods.

Accidents

Accident Problems of Electric Companies (83239 A). P. Frank Day. 1500 w. Sfty Eng—Dec., 1917. Abstract of paper at Welfare and Efficiency Conference. Plant hazard, human element, lamp trimmers.

Benefit Association

The Employeers Benefit Association (83291 A). W. L. Chandler. Illus. 6000 w. Ind Man—Jan., 1918. Serial, 1st part. How to solve its problems.

Bush Terminal

What the Bush Terminal Is Doing for Its Employees (83307 A). Daniel Bloomfield. 1500 w. Ind Man—Jan., 1918. Account of work for the protection, health and thrift of employees.

Canteens

The Establishment and Management of Engineering Works' Canteens (83070 A). Arthur F. Agar. Read before Manchester Assn. of Engrs. 3000 w. Engng—Nov. 30, 1917. Their arrangements for feeding workers.

Fire Protection

Factory Fire Protection (83227 B). J. C. Gillette, with discussion. 20 pp. Cleve Eng Soc, Jl—Nov., 1917. Instructions and rules for prevention of fires.

Industrial Health

Cost of Industrial Health Supervision (83298 A). Reginald Trautschold 5000 w. Ind Man—Jan., 1918. Statistics giving actual cost figures of healtl supervision.

Insurance

Our Group Insurance Plan (83308 A) A. J. Schneider. 1200 w. Ind Man—Jan., 1918. Describes plan of the Cincinnati Planer Co.

Low Voltages

Industrial Hazards of Low Voltage (82805). Charles A. Lauffer. 3000 w Elec Jl—Dec., 1917. Hazards fron circuits of 600 volts and less.

Oil Fires

The "Foamite" System for Extinguishing Oil Fires (83240 A). Ills 2000 w. Sfty Eng—Dec., 1917. Thi method explained in detail.

Rescue Apparatus

Oxygen Mine Rescue Apparatu (82937). F. W. Gray. 3300 w Ca Min Jl—Dec. 1, 1917. Informatio from bulletin of U S Bureau of Mine prepared by Dr. Yandell Henderso and James W. Paul. Deals with cha acteristics of existing types, their lim tations, and possible improvement.

Safety Methods

Old and New Safety Methods (82750 F. S. Riordan. Ills. 1800 w. Cl A —Dec., 1, 1917. Changes that ha taken place and the results.

Safety Methods in the Electrical I dustry (82755). H. J. Burton. 2000 Elec Wld—Dec. 1, 1917. Rules, pra tices, and precautions that should observed.

TNT Poisoning
Prevention and Treatment of Poisoning by Trinitrotoluol and Picric Acid (83242 A). R. W. Chaffee. 1200 w. Sfty Eng—Dec., 1917. Precautions, etc.

MISCELLANY

Engineering Discussion
Under New Management—The Fallacy of Engineering Discussion (83288 A). Charles M. Horton. 3500 w. Ind Man—Jan., 1918. Interesting essay.

Inventions
Discovery and Invention (83091 A). Dugald Clerk, with discussion. Trueman Wood lecture. 11000 w. Roy Soc Arts, Jl—Dec. 7, 1917.

Never made in Germany (82731). Townes R. Leigh. 2000 w. Mfrs' Rec—Nov. 29, 1917. Proving that the great inventions that advanced civilization were not of German origin.

Science and Its Functions (83022 A). Alan A. Campbell Swinton. Chairman's address. 10000 w. Roy Soc Arts, Jl—Nov. 23, 1917. Early scientific methods and inventions, their development and history, aims and functions.

The United States Towers Supreme in Practical Inventions Among the Nations of the Earth (83120). Townes R. Leigh. 2200 w. Mfrs' Rec—Dec. 20, 1917. The role America has played in inventions.

Russia
Russia—An Opportunity for American Engineers (83260 B). George C. Whipple. 28 pp. Bos Soc Civ Engrs, Jl—Dec., 1917. Facts gathered during a recent journey through Russia.

War
The Great War and the Work Ahead (83310 A). 2500 w. Ind Man—Jan., 1918. Editorial on the future outlook for United States.

War Aims
What Are We Fighting For? (83039). William H. Taft. 6500 w. Power—Dec. 18, 1917. Address to the A S M E, New York City, Dec. 4, 1917, on "The Nation's Call to the Professional Man."

MECHANICAL ENGINEERING

AERONAUTICS

Aerial Propellers
Theory and Operation of Dr. Zahm's Propeller Computer (82981 B). W. P. Loos. Ills. 700 w. Fkn Inst, Jl—Dec., 1917. Theory and construction.

Aeroplanes
The Armament of Aeroplanes (83063 A). Ills. 1500 w. Engng—Nov. 23, 1917. Reviews types adopted on different aeroplanes.

The S. V. A. Fighting Scout (82757). Ills. 1200 w. A A Wkly—Dec. 3, 1917. Detailed description of these machines, built in Genoa.

Aeroplani Velocissimi (83300 C+D). A. Guidoni. Ills. 2200 w. Rivista Marittima — Sept., 1917. High-speed aeroplanes. Calculation and curves showing ratio of horsepower and speed.

Aircraft
Commercial Aeronautics (83090 A). Mervyn O'Gorman, with discussion. 9000 w. Roy Soc Arts, Jl—Dec. 7, 1917. Aerial transport and travel considered.

Commercial Airplanes in Near Future (83123). W. B. Stout. Ills. 300 w. Auto Ind—Dec. 20, 1917. Read before S A E. The outlook, safety, etc.

International Aircraft Standards (82,758). Ills. 4500 w. A A Wkly—Dec. 3, 1917. Serial, 1st part. Specifications adopted by the International Aircraft Standards Board.

Airplanes
Metal Frames and Fittings for Airplanes (83098). Fred H. Colvin. Ills. 1000 w. Am Mach—Dec. 20, 1917. Ways in which metal is supplanting wood.

Problems in Airplane Production (83172 B). W. F. Durand. 2200 w. S A E, Jl—Dec., 1917. Questions that arose for immediate consideration and the general character of the answers.

Some Recollections of the Langley Airplane (82852). An interview with Charles M. Manly. 1800 w. Am Mach—Dec. 6, 1917. Early experiments and their bearing on development.

Airscrew
Some Notes on the Airscrew and the Problem of Optimum Diameter (83152). E. P. King. Ills. 2000 w. A A Wkly—Dec. 24, 1917. Shows methods of determination which may be employed.

Biplanes
The Continental Pusher Biplane (83,258). Ills. 800 w. A A Wkly—Dec. 31, 1917. Specifications and description of a successful type.

Engines
The 320 H.P. Lancia Aeroplane Engine (83151). Ills. 1000 w. A A Wkly—Dec. 24, 1917. Detailed description.

Flying Boats
Austrian Ago and Lohner Flying Boats (83149). Ills. 900 w. A A Wkly—Dec. 24, 1917. Details of types named.

Seaplanes
Seaplanes on Water (82880 A). Godfrey L. Cabot. Ills. 3000 w. Flying—Dec., 1917. Suggestions of interest to fliers by water.

Stability
Stability in General (82998). Harlan D. Fowler. Ills. 3000 w. A A Wkly—Dec. 17, 1917. Serial, 1st part. Consideration of stability on all present forms of aircraft, giving mathematical laboratory solutions.

AUTOMOBILES

Crankshafts
Problems of Crankshaft Design (82,715 B). Otto M. Burkhardt, with discussion. Ills. 7500 w. S A E, Jl—Nov., 1917. Discusses balancing crankshafts of internal combustion engines and related topics.

Engines
The Howard Cuff Valve Engine (83,023 A). Ills. 2500 w. Autocar—Dec. 1, 1917. Attempt to combine the good points of sleeve and poppet valves and of overcoming their principal objections.

Why Water Injection May Cause an Increase of Power (83121). P. M. Heldt. 2000 w. Auto Ind—Dec. 20, 1917. Conversion of heat into mechanical energy most efficient at middle part of stroke.

Fuels
Coal Gas as Motor Fuel (83086 A). P. G. G. Moon. Ills. 1800 w. Autocar—Nov. 10, 1917. Suggestions connecting the use of coal gas, stored in collapsible containers, as fuel for cars.

Fuel, Storage
The Wood-Milne Gas Container (83,087 A). Rayner Roberts. 2000 w. Autocar—Nov. 10, 1917. Possibility of alternative types for high and low-pressure storage.

Ignition
Magneto Ignition (83259). Ills. 3500 w. A A Wkly—Dec. 31, 1917. Serial, 1st part. Explanation of the fundamental principles and general arrangement of H. T. Magnetos.

Magneto vs. Battery Ignition (83,177 B). J. A. Williams. Ills. 4500 w. S A E, Jl—Dec., 1917. Favors modern high-tension magneto.

Jack
The B. G. R. Hydraulic Jack (83055 A). Ills. 1700 w. Autocar—Nov. 24, 1917. An engine-operated system.

Japan
Japan Wants Small Chassis (83252). H. Sibley. Ills. 2000 w. Auto Ind—Dec. 27, 1917. Requirements to meet conditions.

Plowing
Graphs Show Cost of Plowing (82,950). E. Goldberger. 2000 w. Auto Ind—Dec. 6, 1917. Quick method of comparing cost of work with different sizes of tractor and different depths of plowing on average soil.

Racing
Racing, Its Advantages, and Its Influence on Automobile Design (82894). Robert Bruce White. 2000 w. Wis Engr—Nov., 1917. Developments attributed to racing.

Reducing Valve
The Flugel Pressure Reduction Valve (83085 A). Ills. 1500 w. Autocar—Nov. 10, 1917. A device necessary between the container and the engine when coal gas is stored at high pressure.

Springs
Spring Design for Easy Riding (83,175 B). Walter C. Keys, with discussion. Ills. 6000 w. S A E, Jl—Dec., 1917. Types of suspension, functions of rear springs, riding qualities, etc.

Steam Engines
Steam Engines in the Automotive Field (82716 B). E. T. Adams. 2500 w. S A E, Jl—Nov., 1917. Advantages, types of boiler design, economics, etc.

Steam Wagon
Six-Ton Steam Wagon (83134 A). Ills. 1200 w. Engr—Dec. 7, 1917. Describes leading features of vehicle built in England.

Testing
Laboratory Testing in the Automotive Industry (82714 B). R. M. Anderson, with discussion. 7800 w. S A E, Jl—Nov., 1917. Scope of the work, justifying the expense.

Tractors
Design of an Enduring Tractor (83,174 B). F. H. Craven. 3500 w. S A E, Jl—Dec., 1917. Details of an eight-year-old type and its performance in service.

Tractor Lighting, Starting and Ignition (83176 B). Burns Dick. 2000 w. S A E, Jl—Dec., 1917. The question of standardization.

Trundaar Tractor of the Creeper Type (82984). Ills. 1500 w. Auto Ind—Dec. 13, 1917. Tread built on log-chain principle.

Trucks

Complete Design of Class AA Truck (83122). 1500 w. Auto Ind—Dec. 20, 1917. Features of the new design.

Europe's Aviation Truck Design (83,-250). W. F. Bradley. Ills. 1500 w. Auto Ind—Dec. 27, 1917. Types and requirements.

Industrial Trucks in Freight Congestion Relief (83143). F. C. Myers. Ills. 1500 w. Elec Wld—Dec. 22, 1917. Advantages from use of electrically propelled carriers.

New Electric Truck Service Ready in Chicago (83276). Ills. 3500 w. Elec Rev, Chi—Dec. 29, 1917. New station with complete garage and maintenance service.

COMBUSTION MOTORS

Diesel Engines

Automatic Control of Blast Pressure for Diesel Engines (82831 A). Herbert S. Russell. Abstract of paper before the Diesel Engine Users' Ass'n. Ills. 1200 w. Elec Rev—Nov. 16, 1917. Devices for controlling the air pressure.

Light Diesel Engine Possible (83251). Cole Newman. 1500 w. Auto Ind—Dec. 27, 1917. Suggests a modified cycle combined with compound expansion.

Fuels

Alcohol as a Source of Power (83077 A). W. T. Rowe. 3000 w. Engr—Nov. 30, 1917. Its use as a fuel for internal combustion engines; sources of alcohol and cost of production.

Gas Furnaces

Gas Furnaces: Their Design and Manipulation (82830 A). Arthur Forshaw. Read before Manchester Dist. Jun. Gas Assn. 7500 w. Engng—Nov. 16, 1917. Serial, 1st part. Types of furnaces and processes in use, etc.

Oil Engines

Oil Engines (82744). 1500 w. Pwr Pt Eng—Dec. 1, 1917. Points relating to their operation

HEATING AND COOLING

Air Conditioning

Apparatus for Cooling, Drying and Purifying Air (82705 A). W J. Baldwin. Ills. 1200 w. A S M E, Jl—Dec., 1917. Details of the device and its uses.

Air Heaters

Air Heater for Motor Car Carburetters (83079 A). Ills. 1000 w. Engr—Nov. 30, 1917. Details of types of "Calo" air heaters.

Ammonia Compressor

A Five-Hundred-Ton, High-Speed, Booster Ammonia Compressor (82,-898 B). F. L. Fairbanks, with discussion. 3500 w. A S R E, Jl—Nov., 1917.

Bogasse

See same heading under MECHANICAL ENGINEERING, *Steam Engineering*.

Camp Heating

The Heating Equipment for a Great Military Camp (83109). Ills. 1200 w. Ht & Vt Mag—Dec., 1917. Details of the installation at Camp Upton, Yaphank, L. I.

Heat Transfer

Heat Transfer from Air to Pipes (82809 B). Charles H. Herter, with discussion. Ills. 6000 w. A S R E, Jl—Nov., 1917. Investigations of heat transfer problems.

The Transfer of Heat Between a Flowing Gas and a Containing Flue (82923 A). Lawford H. Fry. 32 pp. A S M E—Dec., 1917. Formula with description.

Hot Water

Domestic Hot-Water Supply Systems (82891). Ills. 2000 w. Trav Stand—Dec., 1917. Systems used and necessary precautions.

Ice Plants

The Electrically Operated Ice Plant (82897 B). H. Sloan, with discussion. 28 pp. A S R E, Jl—Nov., 1917. The development; the problem of obtaining a well-balanced plant, etc.

Industrial Buildings

Heating of Industrial Buildings (83,-135 A). Ills. 500 w. Engr—Dec. 7, 1917. Describes the "Industria" air heater.

Heating and Ventilating of Loft Buildings (82745). Charles L. Hubbard. Ills. 4000 w. Natl Engr—Dec., 1917. Chief features of equipment described and service demands computed.

Surface Resistance

A Study of Surface Resistance with Glass as the Transmission Medium (82920 A). H. R. Hammond and C. W. Holmberg. Ills. 10 pp. A S M E—Dec., 1917. Investigations in the thermal testing plant of the Penn. State College, giving a formula.

Ventilation

Ventilation Test of the Lewis Champlin School (83110). Ills. 2500 w. Ht & Vt Mag—Dec., 1917. Serial, 1st part. Gives conditions found in Chicago school building equipped with latest type of heating and ventilating system.

HYDRAULIC MACHINERY

Centrifugal Pumps

Characteristics and Specific Speeds of Centrifugal Pumps (83018 F). F. G. Hechler. Ills. 5000 w. Am Soc Nav Engrs, Jl—Nov., 1917. Deals with their operation and probable performance under various conditions.

Mill Pumping

Mill Pumping Systems (82759 A). A. W. Allen. 1800 w. Met & Chem Eng—Dec. 1, 1917. Adaptation of various systems to the pumping of water, slime pump and sand pump, for low medium, and high lifts.

Pumps

One-Hundred-and-Ten-Million Gallon Pump for St. Louis (82774). H. F. Gauss. Ills. 1200 w. Power—Dec. 4, 1917. A steam-turbine driven centrifugal pump having a maximum capacity of 110,000,000 gal. against a head of 65 feet.

Some Notes on Air-Lift Pumps (83,-065 A). A. W. Purchas. Ills. 3500 w. Engng—Nov. 23, 1917. Serial, 1st part. Read before Inst of Mech Engrs. Account of several series of tests, with description of methods and equipment.

The Automatic Control of Electrically Driven Hydraulic Pumps (83080 A). 800 w. Engr—Nov. 30, 1917. From a lecture, by Alfred Towler, before Leeds Ass'n of Engrs.

Syphons

The Flow of Water in Syphons (83,-115 N). Mark Halliday, with discussion. Ills. 1200 w. Instn Min Engrs, Trans—Nov., 1917. Analysis of the flow of water in syphons, simple and compound.

Turbines

Speed Considerations in Water Power Developments (82887 A). R. E. Neale. 3000 w. Eng Rev—Nov. 15, 1917. Details of a new turbine attracting attention in Norway, Sweden, and Germany—the Kaplan turbine.

MACHINE ELEMENTS AND DESIGN

Bearings

Ball Bearings for Electric Motors (83099). George Andrus. 2500 w. Am Mach—Dec. 20, 1917. Discussed from the standpoint of the user.

Care and Refitting of Engine Bearings (82747). C. H. Willey. Ills. 3000 w. Natl Engr—Dec., 1917. Locating knocks, adjusting bearings, etc.

Gears

Economical Production of Accurate Hardened Gears (82781 A). F. B. Jacobs. Ills. 2500 w. Machy—Dec., 1917. Methods and fixtures used by progressive automobile manufacturers.

The Inspection of Gearing (82712). B. F. Waterman. 2500 w. Am Mach—Nov. 29, 1917. Methods used by Brown & Sharpe Mfg. Co.

MACHINE WORKS AND FOUNDRIES

Annealing

The Annealing of Metals (82962 N). F. C. Thompson, with discussion. 3000 w. Faraday Soc, Trans—June, 1917. Practical aspects of the problem.

Boring

Reboring Gas-Engine Cylinders (83,-202 A). Ills. 1200 w. Mech Wld—Dec. 7, 1917. Details of methods used in reboring a cylinder with no plant at hand except a foot-lathe or two.

Broken Hubs

Repairing a Cracked Irregular Hub (83100). J. V. Hunter, Ills. 1200 w. Am Mach—Dec. 20, 1917. Successful method.

Carburizing Plant

A Well-Arranged Carburizing Plant (82783 A). C. B. Langstroth. Ills. 1500 w. Machy—Dec., 1917. Plan and description of arrangement.

Crucible Furnaces

Building a High-temperature Fuel Furnace for Crucibles (83150 A). Walter J. May. Ills. 1200 w. Mech Wld—Dec. 14, 1917. Construction of such furnaces.

Some Improvements in Crucible Furnaces (83124). Charles Vickers. Ills. 1300 w. Brs Wld—Dec., 1917. Details of contrivances for the improvement of such furnaces.

Drills

The Care, Use, and Abuse of Drills (82814 A). J. Francis. 1000 w. Mech Wld—Nov. 16, 1917.

Electric Motors

Manufacturing Small Electric Motors (82710). M. E. Hoag. Ills. 2000 w. Am Mach—Nov. 29, 1917. Interesting methods used.

Electrometallurgy

Electric Furnace Manufacture of Shoes and Dies on the Witwatersrand (83220 N). George H. Stanley. Also, Electric Steel-Melting Plant. W. Buchanan. Two papers discussed together. 15 pp. Chem, Met, & Min Soc of S Af, Jl—Sept., 1917. Methods, type of furnace and plant, etc.

Factories

A Feminist Munition Factory (83084 A). Ills. 1200 w. Autocar—Nov. 10, 1917. Particulars of a factory in Scotland organized solely for educated women as workers.

Factory Lighting

The Problem of Artificial Light (83287 A). C. E. Clewell. Ills. 3500 w. Ind Man—Jan., 1918. How to evaluvate lighting costs as a proportion of wages.

Foundries

Cincinnati Foundry for Making Special Castings (82798). Ills. 1500 w. Fndry—Dec., 1917. Details of equipment of foundry designed for gray iron, malleable, and semi-steel castings.

Organizing a Malleable Iron Foundry on 90 Days (82795). Ills. 2500 w. Fndry—Dec., 1917. How difficulties were overcome at a foundry in Richmond, Ind.

Foundry Equipment

Solving Foundry Transportation and Conveying Problems (82800). Robert E. Newcomb. Abstract of paper before Am. Fundry. Assn. Ills. 3500 w. Fndry—Dec., 1917. Design and application of modern labor-saving equipment.

Foundry Lighting

How to Solve a Foundry Lighting Problem (82797). C. E. Clewell. Ills. 1500 w. Fndry—Dec., 1917. Fundamental principles of illumination.

Guns

The Manufacture of the Lewis Machine Gun (82851). Frank A. Stanley. Ills. 1200 w. Am Mach—Dec. 6, 1917. Serial, 1st part. Workmanship involved in manufacturing on a strictly interchangeable basis.

Hardware

Manufacturing Hardware for Reënforced Ammunition Boxes (82711). F. E. Merriam. Ills. 1500 w. Am Mach—Nov. 29, 1917. Shows what can be accomplished in press work with little equipment.

Heat Treatment

Heat Treatment and Temperature Measuring for Shells (83101). J. R. Van Wyck. Ills. 2500 w. Am Mach—Dec. 20, 1917. Successful method used in the manufacture of 2,000,000 three-inch Russian shrapnel shells.

New Steel Works Heat-Treating Plant (82861 A). Ills. 1000 w. Iron Age—Dec. 6, 1917. At Canton, Ohio. Continuous automatic furnace for long round bars.

Inspection

Inspection (83106 N). R. K. Bagnall-Wild. 36 pp. Instn Aut Engrs—Oct., 1917. Presidential address to Instn. Aut. Engrs. of Gt. Britain. Why necessary. Methods, etc.

Inspectors and Inspection (83102) W. B. Seigle. 1500 w. Am Mach—Dec. 20, 1917. Problems that confront inspectors in their work.

The Inspection of Screw Gages for Munitions of War (83007). H. J. Bingham Powell. Ills. 7000 w. Am Mach—Dec. 20, 1917. Describes instruments needed and desirable methods.

Ironwork

The Ironwork of Jean Tijou (83266) R. Randal Phillips Ills. 2000 w. Arch For—Dec., 1917. Serial, 1st part. Details of his craftmanship at Hampton Court, England.

Machine Foundations

Foundations for Planers (83053). Terrell Croft. Ills. 4000 w. Am Mach—Dec. 13, 1917. Requirements, modern planer foundations, and methods of installing.

Plane Motion

General Theory of Plane Motion Rotation and Translation (83012 A) Francis W. Roys. 1500 w. Worc Poly Inst—Nov., 1917. Develops equations which may be used in solving engineering problems.

Press

The Cut and Carry Type of Press (83051). G. R. Smith. Ills. 2000 w. Am Mach—Dec. 13, 1917. Details of machine and description of some of the work.

Production

Relation of Quantity Production to Cost (83299 A). A. G. Popcke. 3500 w. Ind Man—Jan., 1918. Labor analysis of manufacturing a shaft in lots of 1 to 200 pieces.

Rustproofing

Rustproofing Iron and Steel (82780 A). Joseph W. Wunsch. Ills. 2200 w. Machy—Dec., 1917. Advantages and limitations of phosphatic treatment.

Shop Practice

Manufacturing a Calculating Machine in a Western Shop (82854). Frank A. Stanley. Ills. 1500 w. Am Mach—Dec. 6, 1917. Details of numerous tools and processes.

Methods of the Nash Motors Co. (83213). Ills. 1200 w. Am Mach—Dec. 27, 1917. Serial, 1st part. Applications of single-purpose machines.

Progressive Battery Manufacture (82951). Ills. 2500 w. Auto Ind—Dec. 6, 1917. Conveyor system used extensively.

Shops

A Big Jobbing Shop and Foundry in Texas (83214). Frank A. Stanley. Ills. 2500 w. Am Mach—Dec. 27, 1917. Methods used in handling large work in machines generally considered inadequate.

Spain

Machine Tools in Spain (82855). Henry S. Moos. 2000 w. Am Mach—Dec. 6, 1917. Present and future trade prospects.

Steel-Cutting

Oxy-Acetylene Steel Cutting (83106 A). William Herron. Ills. 3500 w. Weld Engr—Dec., 1917. Cutting action of oxygen, design of torches, methods, etc.

Tapping Machines

Tapping Machines and Attachments (82782 A). Franklin D. Jones. Ills. 9 pp. Machy—Dec., 1917. Types, methods, and auxiliary appliances.

Tool Design

Technical vs. Practical Tool Designers (83054). Donald A. Baker. Ills. 1800 w. Am Mach—Dec. 13, 1917. Encouragement for the practical designer.

Tool Design in the Manufacture of Munitions (82778 A). 3500 w. Machy—Dec., 1917 Account of changes made in a Canadian plant, economies effected, lessons taught by experience, etc.

Tool Works

A New Tool Works at Timperley (83076 A). Ills. 1200 w. Engr—Nov. 30, 1917. Details of works for manufacture of twist drills.

Welding

British Welders and the World War (83104 A) Frank Mynott 1500 w Weld Engr—Dec, 1917 Applications of welding to war work

Repairing German Vandalism by Electric Welding (83015 F). E. P. Jessop. Ills. 4000 w. Am Soc Nav Engrs, Jl—Nov., 1917 Details of work successfully carried out by electric welding methods.

Electric Arc Welding (82777 A) Erik Oberg Ills 18 pp. Machy—Dec, 1917 Principles of this process and the field for which it is best suited.

Welding Cast Iron with the Electric Arc (83197 A). Robert E. Kinkead. 1000 w. Weld Engr—Dec., 1917. Suggestions for successful work.

Heat Production in the Electric Arc (83195 A). Otis Allen Kenyon. Ills. 800 w. Weld Engr—Dec., 1917. Results of tests.

Welding (82806 B). Charles Hollup, with discussion. Ills. 33 pp. A S R E, Jl—Nov., 1917. Methods, preparation, tests, and practical examples of welding refrigerating machinery.

Welding Main Engine Cylinders (83016 F). H. G. Knox. Ills. 2000 w. Am Soc Nav Engrs, Jl—Nov., 1917. Work on the German ships "Neckar," "Rhein" and "Bulgaria."

MATERIALS OF CONSTRUCTION

Alloys

Alloys of Aluminum and Copper (83125). Charles Vickers. Ills. 1000 w. Brs Wld—Dec., 1917. Their use for castings.

Engineers Non-Ferrous Alloys (82866 A). W. Rawlinson. Read before Jun. Inst. of Engrs. 1500 w. Mech Wld—Nov. 23, 1917. Serial, 1st part. Theory and constitution of alloys.

Aluminum

Recently Developed Uses of Aluminum in Industry (82799). F. G. Shull. 1200 w. Fndry—Dec., 1917. Read before Am. Inst. of Metals. Ability to weld and roll aluminum extended its application.

The Changes in Physical Properties of Aluminum with Mechanical Work (82963 N). F. J. Brislee, with discussion. Also, a Note on the Annealing of Aluminum. Richard Seligman and Percy Williams. 9 pp. Faraday Soc, Trans—June, 1917. Second part. Deals with specific heat of aluminum.

Axle Steel

The Science of Preparing Car Axle Steel (82771). W. L. Allen. Ills. 3500 w. Elec Ry Jl—Dec. 1, 1917. Analysis of causes of failure and discussion of special treatment to eliminate weaknesses.

Brass Pipe

Dezincification of Brass Pipe (82764 A). Edward B. Story. Ills. 1500 w Met & Chem Eng—Dec. 1, 1917. Failure due to the dissolution of zinc as a result of electrolysis.

Ferro-Manganese

Bibliography of the Manufacture of Ferro-Manganese (82761 A). E. C. Buck. 4 pp. Met & Chem Eng—Dec. 1, 1917.

Refractories

Refractory Materials—A General Discussion (82964 N). Introductory address by Sir Robert Hadfield. Ills. 188 pp. Faraday Soc, Trans—June, 1917. Papers, discussions, bibliography, etc.

Research on Refractory Materials (83081 A). G. E. Foxwell. 2000 w. Ir & Cl Trds Rev—Nov. 23, 1917. Study of brick burning.

Ropes

Considerations in the Selection and Use of Hoisting Ropes (83180). H. C. Behr. 3300 w Eng & Min Jl—Dec. 22, 1917 Discussion on factors of stress and safety.

History of Wire Hoisting Ropes with Notes on Factors of Safety (82753). M H. Sigafoos. 1500 w Cl Age—Dec. 1, 1917. History and suggestions.

The Factor of Safety of Wire Ropes Used for Winding in Mine Shafts (83218 N) J A Vaughan, with discussion. 0000 w S Af Instn Engrs, Jl—Nov., 1917. Methods of estimating strength, etc.

Rubber

Effect of Copper on Crude Rubber (82786 B). Charles P. Fox. 1200 w. Jl Ind & Eng Chem—Dec., 1917. Results of tests.

The Production and Preparation of Raw Rubber (82837 A). Ills. 4500 w. Engr—Nov. 9, 1917. Serial, 1st part. Deals with plant and machinery made by British firms. Rubber bearing plants, collection of rubber latex, etc.

Storage

The Need for Storage Facilities (83246). Francis Lee Stuart. 1200 w. Ry Age Gaz—Dec. 28, 1917. Address at meeting of the Acad. of Pol. Sci. Recommendations of Terminal Port Facilities Committee and Storage Committee of the War Industries Board.

Textiles

The Moisture Content of Textiles and Some of its Effects (82919 A). William D. Hartshorne. Ills. 53 pp. A S M E—Dec., 1917. Develops a set of laws governing regain in cotton and worsted. Charts and tables.

MEASUREMENT

Anemometers

Calibration of Anemometers (83108). A. H. Anderson. Ills. 600 w. Ht & Vt Mag—Dec., 1917. Gives data showing that the method of calibrating anemometers by swinging in a short radius is quite erroneous.

Balancing

Enter the "Balancing Engineer" (83286 A). N. W. Akimoff. 700 w. Ind Man—Jan., 1917. Need of the balancing engineer, kind of training required, and his work.

Recent Development in Balancing Apparatus (82703 A). N. W. Akimoff. Ills. 2500 w. A S M E, Jl—Dec., 1917. Improvements, and a new machine based on new methods of balancing. Results secured.

Blower-test Curves

Plotting Blower-Test Curves (82928 A). A. H. Anderson. Ills. 6 pp. A S M E—Dec., 1917. Another method and its application to problems.

Calculator

A Logarithmic Calculator (83219 N). D. R. Robinson. Ills. 1000 w. Chem, Met, & Min Soc of S Af, Jl—Sept., 1917. Describes instrument and its use.

Condensers

Capitalized Value of One-Tenth of an Inch of Vacuum (82776). C. H. Baker. Charts. 500 w. Power—Dec. 4, 1917. Formulae and charts for calculating the capital that may be economically invested in condenser equipment.

Fusion Apparatus

Some Notes on Fusion Apparatus (83002 A). Frederick Pope. Ills. 2500 w. Met & Chem Eng—Dec. 15, 1917. Design and construction of several types of autoclaves and fusion kettles.

Gauges

Precision Gauges (83088 A). H. J. Rickwood. 2200 w. Mech Wld—Nov. 30, 1917. Principles involved, types, etc.

Lubricants

Lubricant Testing (83019 F). G. J. Meyers. Ills. 2500 w. Am Soc Nav Engrs, Jl—Nov., 1917. Describes a machine for investigating the desirable characteristic of lubricants.

Nozzles

The Divergence of Steam Nozzles (83130 A). Gerald Stoney. 400 w. Engng—Dec. 7, 1917. Method of calculation.

Pyrometry

Pyrometers and Pyrometry (82967 N). Ills. 50 pp. Faraday Soc—Nov. 7, 1917. Contributions by various authors, to a general discussion. Seven papers.

Pyrometers and Pyrometry (82833 A). 5000 w. Elec'n—Nov. 16, 1917. Serial, 1st part. Four papers read at meeting of Faraday Soc, giving a general discussion of the subject.

Slide Rule

Design of Special Slide Rules (83294 A). A. Lewis Jenkins. Ills. 1800 w. Ind Man—Jan., 1918. Third article of a serial giving equations for solution of problems.

Stresses

Combined Stresses (82914 A). A. Lewis Jenkins. 17 pp. A S M E—Dec., 1917. Possible hypotheses upon which a formula may be based.

Photo-Elasticity for Engineers (83105 N). E. G. Coker. Ills. 25 pp. Instn Aut Engrs—Nov., 1917. Uses and applications shown by examples.

Tables

Simple Tables Save Mental Labor (83293 A). G. W. Greenwood. 900 w. Ind Man—Jan., 1917. Explains how tables help and how they are made.

Testing Machine

An Impact-Endurance Testing Machine (83107 F). D. J. McAdam, Jr. Ills. 2000 w. Am Soc Nav Engrs, Jl—Nov., 1917. Describes new machine found to give satisfactory results.

Twisting and Binding

Combined Twisting and Bending Moments (82779 A). Victor M. Summa. 1500 w. Machy—Dec., 1917. Formulæ and their applications. Mathematical.

POWER AND TRANSMISSION

Air Hose

Economy of Tight Air Hose Connections (82853). Glenn B. Harris. 2000 w. Am Mach—Dec. 6, 1917. Remedies to prevent costly waste of power.

Hospital Equipment

Engineering Equipment of a Modern Hospital (82997). J. J. Becker. Ills. 1500 w. Pwr Pt Eng—Dec. 15, 1917. Dual sources of supply at Danville, Pa., memorial hospital.

Lubrication

Lubrication of Air Compressors (83045 A). Abstract of article in Lubrication. 2500 w. Ry Mech Engr—Dec., 1917. Problems encountered, and characteristics of oil to be used.

Michell's Automatic Lubricating Gear (83064 A). Ills. 2000 w. Engng—Nov. 23, 1917. New type of apparatus developed for the purpose of lubricating bearings during starting and stopping.

Merits of Oil and Grease Lubrication (83187). W. J. Fouhy. 2000 w. Elec Rev, Chi—Dec. 22, 1917. Free flowing oil gives best lubrication.

Power

Conditions in the Power Industry (82935). Ludwig W. Schmidt. 2500 w. Power—Dec. 11, 1917. Digest of reports of U. S. Consuls on the power situation in various parts of the world and the influence of the war.

Tanks

Displacement—Tanks (83029). Walter S. Weeks. Ills. 900 w. Min & Sci Pr—Dec. 15, 1917. Details of construction; proper form of contact-plug: general drawing of water.

STEAM ENGINEERING

Bagasse

Bagasse as a Source of Fuel (82924 A). E. C. Freeland. 8 pp. A S M E—Dec., 1917. The heating value of this fuel to the sugar industry, and benefits of drying.

Boiler Code

Revision of Boiler Code (82706 A). Ills. 4500 w. A S M E, Jl—Dec., 1917. Modifications and additional revisions.

Boilers

Materials of Steam Boiler Construction (82775). A. J. Dixon. 2500 w. Power—Dec. 4, 1917. Facts concerning different grades of steel used for boiler making.

Die Stützung von Dampfkesseln und von Wasserleitungen (83314 B). E. Höhn. Ills. 2300 w. Schweizerische Baw Zeitung—Nov. 3, 1917. Strength of steam boilers, and water circulation.

Conbustion

Economy of Automatic Combustion Control (82907). I. L. Kentish-Rankin. 1500 w. Elec Rev, Chi—Dec. 8, 1917. Its aid in conserving the coal supply and lessening labor difficulties.

Condensers

See same heading under Measurement.

Fuel Economy

Methods to Improve Plant Fuel Economy (83211 A). S. J. H. White. 2000 w. Iron Age—Dec. 27, 1917. Care of purchased power. Suggestions on boiler practice.

Fuel Saving Suggestions (82934). Charles H. Bromley. Ills. 2500 w. Power. Dec. 11, 1917. Sources of fuel loss and how waste may be minimized.

Gas Firing

Gas Firing Boilers (82895 N). T. M. Hunter. 15500 w. Instn E E—Oct., 1917. Study of the subject.

Gas-Firing Boilers (82836 A). T. M. Hunter. 3000 w. Elec'n—Nov. 23, 1917. Serial, 1st part. Abstract of paper before Instn. of Elec. Engrs. Drying and cleaning gas, heat transfer, types of boilers, etc.

Power Plants

Economies in Power-Plant Operation (82906). F. N. Lawton. Ills. 2000 w. Elec Rev, Chi—Dec. 8, 1917. Suggestions for increasing boiler and engine-room efficiency.

Steam Pressures

Advisability of Higher Steam Pressures (82876). J. T. Foster. 1000 w. Elec Wld—Dec. 8, 1917. Curves showing improvement in water rates and thermal efficiencies. Estimate of cost.

Turbines

A Commercial Analysis of the Small Turbine Situation (82702 A). W. J. A. London. Ills. 6000 w. A S M E, Jl—Dec., 1917. Analysis of the four types of small steam turbines, dealing principally with non-condensing units.

Water Cooling

The Cooling of Water for Power-Plant-Purposes (82701 A). C. C. Thomas. Ills. 2000 w. A S M E, Jl—Dec., 1917. Work to ascertain conditions governing the cooling of water by means of spray ponds.

TRANSPORTING AND CONVEYING

Freight Handling

Handling Freight on New York's New Steamship Pier (82859). C. W. Staniford. Ills. 1800 w. Eng News-Rec—Dec. 6, 1917. Latest ideas in equipment details.

Locomotive Cranes

Locomotive Crane Sprang from Small Beginnings (82857). James Shearer. Ills. 2500 w. Eng News-Rec—Dec. 6, 1917. Development and uses, types of power, etc.

MISCELLANY

Dye Industries

The Physical Basis of Color-Technology (82760 A). M. Luckiesh. 6000 w. Met & Chem Eng—Dec. 1, 1917. Résumé of a series of investigations carried out at the Nela Research Laboratory.

War Resources

Building the American War Machine (83433 D). Charles M. Pepper. Photographs. 6000 w. Iron Age—Jan. 3, 1918. (Special No.) How industrial leaders have marshaled their resources.

Leavitt, E. D.

An Account of the Engineering Work of E. D. Leavitt (82925 A). F. W. Dean. Ills. 45 pp. A S M E—Dec., 1917. A review.

War Work

Mechanical Engineers Discuss War Work (82986 A). 6000 w. Iron Age—Dec. 13, 1917. Topics discussed at the annual meeting of A. S. M. E.

ELECTRICAL ENGINEERING

COMMUNICATION

Conductors

Some Experiments With Long Electrical Conductors (83161 D). John H. Morecroft. Ills. 24 pp. Inst Rad Engrs, Pro—Dec., 1917. Study of conductors which may prove useful in calculating antenna oscillation period.

Loading Coils

Loading Coils versus Repeaters (82996 A). W. N. Furthman. 2500 w. Tel Engr—Dec., 1917. Serial, 1st part. Properly designed and correctly installed, loading coils are adequate for all long distance work.

Radiotelegraphy

Municipal Regulations Covering Radio Stations (83163 D). Ellery W. Stone. Ills. 3000 w. Inst Rad Engrs, Pro—Dec., 1917. Discussion of Robert H. Marriott's paper on "Engineering Precautions in Radio Installations."

Distributed Inductance of Vertical Grounded Antennas (83162 D). A. Press. Ills. 500 w. Inst Rad Engrs, Pro—Dec., 1917. A study of the variation of distributed inductance.

On the Phenomena in Resonance Transformer Circuits (83165 D). Hidetsugu Yagi. 13 pp. Inst Rad Engrs, Pro—Dec., 1917. Reviews previous work and develops the solutions for the cases of one and two sparks per cycle.

The Manufacture of Vacuum Detectors (83164 D). O. B. Moorhead, with discussion. 2000 w. Inst Rad Engrs, Pro—Dec., 1917. Experiments and details of manufacture and testing.

Repeaters

See Loading Coils.

Telephony

Recent Progress in Telephony (82995). Ray H. Manson. 5500 w. Telephony—Dec. 15, 1917. Presented at Rochester meeting of A. I. E. E. Trend of improvements advocated.

Telephone Regulation in Illinois (82875). T. E. Dampcy. 3500 w. Telephony—Dec. 8, 1917. Questions in connection with state regulation of telephone companies.

ELECTRO-CHEMISTRY

Corrosion

Corrosion (83126). A. Schleimer. 1500 w. Brs Wld—Dec., 1917. Rust preventive processes.

Fence Wire Corrosion and Its Causes (82987 A). Oliver W. Storey. 3000 w. Iron Age—Dec. 13, 1917. From paper before Elec. Chem. Soc. Influence of copper. Results of study.

Electric Furnaces

Electric Furnace Facts and Practice (83083 A). D. D. Mac Guffie. Read before British Found. Assn. 2500 w. Jr & Cl Trds Rev—Nov. 30, 1917. Practice with a 3-ton Héroult furnace.

Small Electric Furnaces and Their Uses (82839 A). Charles R. Darling. Ills. 1700 w. Engr—Nov. 16, 1917. Improvements that have increased their usefulness. Cost of running; types, etc.

Electrometallurgy

The Future of Electrolytic Zinc (82762 A). Thomas French. 2500 w. Met & Chem Eng—Dec. 1, 1917. Read before Am. Elec-Chem. Soc. Comparative metallurgical and economic future of the retort and electrolytic processes.

ELECTRO-PHYSICS

Ions

On the Nature of the Ordinary Gaseous Ion (82980 B). Leonard B. Loeb. 30 pp. Fkn Inst, Jl—Dec., 1917. A study of the "small ion" theory.

Lightning

Lightning Protection (82743). Terrell Croft. Ills. 2500 w. Pr Pt Eng—Dec. 1, 1917. Serial, 1st part. Types of apparatus employed and their principle of operation.

Magnetic Flux

Magnetic Flux Distribution in Annular Steel Laminae (82949 D). A. E. Kennelly and P. L. Alger. Ills. 18 pp. A I E E. Pro—Dec., 1917. Distribution of alternating magnetic flux density in ring laminae is studied experimentally.

Resistance

Do Equiatomic Solutions in Iron Possess Equal Resistances? (82965 N). E. D. Campbell, with discussion. 4000 w. Faraday Soc, Trans—June, 1917. Experimental work obtain a more satisfactory hypothesis than is offered by Benedick's law.

GENERATING STATIONS

Hydro-Electric

Automatic Power Plant at Cedar Rapids (82769). Ills. 3500 w. Elec Ry Jl—Dec. 1, 1917. Development in Iowa. 2000-kw., low-head generating plant operates in parallel with 1900-kw. steam station.

Electrochemical Development at Shawinigan (83186). Ills. 1400 w. Elec Rev, Chi—Dec. 22, 1917. Hydro-electric development opens vast electrochemical industry in this Canadian city.

Features of an Automatic Hydroelectric Plant (82754). Ills. 3300 w. Elec Wld—Dec. 1, 1917. Details of construction and arrangements for control.

The Automatic Hydro-Electric Generating Station of the Iowa Railway and Light Company (82819 A). L. B. Bonnett. Ills. 2200 w. Gen Elec Rev —Dec., 1917. Details of an automatic station supplementing a large steam-electric station.

Load Relief Map

Annual Load Relief Map, Peak Load and Load Factor Analysis (82946 D). William LeRoy Robertson. Ills. 7 pp. A I E E, Pro—Dec., 1917. Describes a device for visualizing the entire yearly load of central stations.

New England

Water Powers of New England (83261 B). Henry I Harriman. 13 pp. Bos Soc Civ Engrs, Jl—Dec., 1917. Hydroelectric developments in their relation to industrial conditions.

Switchboards

Developments in Switchboard Apparatus (82824 A). Ills. 800 w. Gen Elec Rev—Dec., 1917. Outdoor disconnecting switches, fuses, and choke coils for use up to 150,000 volts.

GENERATORS AND MOTORS

Commutation

Laminated Commutating Poles (82802). C. G. Lewis. Ills. 1000 w. Elec Jl—Dec., 1917. Explains their advantages.

Controllers

Some Fundamental Problems of Industrial Control (83145). C E Clewell, 1500 w. Elec Wld—Dec. 22, 1917. Serial, 1st part. Principal functions of controllers outlined.

Converters

The Commutating-Pole Windings of a Synchronous Booster Converter (82807). M. W. Smith. Ills. 1500 w. Elec Jl—Dec., 1917. Explains how the auxiliary winding compensates for the motor and generator action of the booster.

D. C. Motors

Speed Characteristics of Small D. C. Motors (82804). B. H. Chatto. 1000 w. Elec Jl—Dec., 1917. Conditions of starting and running torque.

The Development of Direct-Current Motors (82801). A. Brunt. 2000 w. Elec Jl—Dec, 1917. Requirements, progress, efficiency, etc.

Generator Tests

Tests of a Small Engine-Generator Set (82959 A). J. E. Emswiler. 1000 w. Mich Tech—Dec., 1917. Extensive economy tests of a 10 kw. engine-generator set.

Induction Motors

Checking Induction Motor Connections (82809). F. D. Newbury. Diagrams. 1000 w. Elec Jl—Dec., 1917. Possible mistakes in connecting three-phase windings.

Mistakes in Induction Motor Windings (82808). A. M. Dudley. Ills. 1500 w. Elec Jl—Dec., 1917. Errors which may occur in winding and connecting.

Prime Movers

The Steam Turbine as Applied to the Driving of Electric Generators (82865 A). C. Grant. 2000 w. Mech Wld—Nov. 23, 1917. Serial, 1st part. Advantages, fundamental difference in types, etc.

Rotary Converters

On the Effect of Armature Resistance and Reactance on the Terminal Pressures of a Rotary Converter (82835 A). S. Neville. 2500 w. Elec'n—Nov. 23, 1917. Serial, 1st part. Difficulty of estimating the influence; methods, etc.

The Pressure Regulation of Rotary Converters (82982 A). R. G. Jakeman. Curves & diagrams. 2500 w. Elec'n—Nov. 9, 1917. Serial, 1st part. Discusses regulation by means of reactance and by means of a synchronous booster.

ILLUMINATION

Factory Lighting

Effective Lighting of Factories as Judged by Daylight Standards (82960 C). Ward Harrison, with discussion. Ills. 4500 w. Ill Eng Soc, Trans—Nov. 20, 1917. Increased efficiency of modern light sources and the benefits.

Practical Features of Factory Lighting (82784 A). C. E. Clewell. Ills. 3000 w. Machy—Dec., 1917. Principal requirements of artificial lighting.

Lamps

Adapting 220-Volt Circuits to 110-Volt Lamps (83144). J. R. Colville. 1000 w. Elec Wld—Dec. 22, 1917. Reduced lamp costs and higher efficiencies, with other advantages.

Modern Arc Lamps and Incandescent Lamps (83108 A). 1200 w. Elec Rev—Dec. 7, 1917. Serial, 1st part. Shows there is a field of application for both types.

Motion-Picture Projectors

Mazda Lamps for Motion-Picture Projectors (82823 A). L. C. Porter. Ills. 1500 w. Gen Elec Rev—Dec., 1917. Analysis of difficulties encountered in successfully developing the system.

Plant Lighting

The Lighting of New York City's New $3,000,000 Garbage Disposal Plant (82822 A). A. L. Powell. Ills. 1800 w. Gen Elec Rev—Dec., 1917. Details of process employed, the products, etc., with lighting requirements and successful solution of the problem.

Residences

The Growth and Present Status of Systems Used in the Maintenance of Gas Lamps in Residences (82961 C). E. B. Myers, with discussion. 3000 w. Ill Eng Soc, Trans—Nov. 20, 1917. Beneficial results of systematic maintenance.

Series, Incandescent

Operation of Series Incandescent Lighting Circuits with Series Transformers (82820 A). E. D. Treanor. Ills. 3000 w. Gen Elec Rev—Dec., 1917. Latest and most highly developed transformer of this type.

Streets

Street Lighting with Modern Electric Illuminants (82821 A). S. L. E. Rose and H. E. Butler. Ills., 2500 w. Gen Elec Rev—Dec., 1917. Covers both incandescent and arc lamps from the illumination standpoint.

MEASUREMENT

Bus-Bars

Repulsion Between Bus-Bars (82803). S. G. Leonard and Charles R. Riker. 2200 w. Elec Jl—Dec., 1917. Charts and explanation of methods of finding the force exerted.

Cross-Currents

Cross-Current Predeterminations from Crank-Effort Diagrams (82918 A). Louis Illmer. Ills. 36 pp. A S M E—Dec., 1917. Research study into causes of excessive cross-current flow between paralleled alternators when driven by reciprocating engines.

POWER APPLICATIONS

Baling

Electric Baling Presses (83131 A). Ills. 1000 w. Engng—Dec. 7, 1917. Particulars of a patent press made in Manchester, Eng.

Electric Cooking

Electric Cooking as Applied to Large Kitchens (83107 N). W. A. Gillott. 10 pp. Instn E E—Nov., 1917. Advantages that justify the installation.

Electrometallurgy

The Electric Furnace and Central Station (82862 A). Edwin L. Crosby. From paper before Am. Fndry. Assn. 2000 w. Iron Age—Dec. 6, 1917. Future of the electric steel furnace.

Magnets

The Lifting Magnet as an Adjunct to the Electric Steel Furnace (82829 A). Ills. 1000 w. Engng—Nov. 16, 1917. Details of magnet and its uses.

Motor Drive

Factors Affecting Application of Motors to Lathes (83257). C. E. Clewell. Ills. 2000 w. Elec Wld—Dec. 29, 1917. Ninth article of a series on industrial control.

A Study of Group and Individual Motor Drive (82756). C. E. Clewell. Ills. 1500 w. Elec Wld—Dec. 1, 1917. Conditions under which group drive is favorable. Advantages of individual drive.

Speed, Torque and Power in Machine-Tool Work (82877). C. E. Clewell. 2000 w. Elec Wld—Dec. 8, 1917. Serial, 1st part. Some factors to consider in selecting motors.

Pumping

Electrically Operated Pumping System of New Orleans (83185). Ills. 1800 w. Elec Rev, Chi—Dec. 22, 1917. Details of water, sewage and drainage systems.

Pumping Stations

Electrically Operated Pumping Stations at Rochester (82773). Sydney Alling and John H. Allington. Ills. 3000 w. Elec Rev, Chi—Dec. 1, 1917. How motor-driven centrifugal pumps served from central-station lines make efficient combination.

Refrigeration

Electricity in Raw-Water Ice Plants (83030). Ills. 3500 w. Elec Rev, Chi—Dec. 15, 1917. Details of typical plants.

Welding

See same heading under Mechanical Engineering, Machine Works and Foundries.

TRANSFORMERS

Connections

Phenomena Accompanying Transmission with Some Types of Star Transformer Connections—II (82948 D). Lloyd N. Robinson. 30 pp. A I E E, Pro—Dec., 1917. Second paper.

Cooling

Methods of Cooling Transformers (83192). Arthur Palme. Ills. 3000 w. Power—Dec. 25, 1917. Different types of transformer tanks are discussed.

TRANSMISSION AND DISTRIBUTION

Bus Work

The Utilization of Pipe for Outdoor Bus Work (83256). M. M. Samuels. Ills. 350 w. Elec Wld—Dec. 29, 1917. Charts giving deflections of copper, brass and iron pipe with and without ice load designed for high-tension apparatus.

Conductors

Effects of Unsymmetrically Spaced Conductors (82879). George S. Humphrey. Ills. 3000 w. Elec Wld—Dec. 8, 1917. Practical effects of unbalanced loads and unsymmetrical spacing of conductors on the voltage drop in distribution lines.

Corona Tests

Corona Tests at High Altitude (82947 D). B. F. Jakobsen. 17 pp. A I E E, Pro—Dec., 1917. Tests made in Peru on a 70-mile transmission line located at an average altitude of 13,500 feet. The voltages range from 40,000 to about 72,000.

Drop Curves

Pressure Drop Curves for Copper Overhead Lines (82828 A). G. N. Wright. 1000 w. Engng—Nov. 9, 1917. Read before the Instn. of Elec. Engrs. Explanatory note for finding the true pressure drop.

Extension Problems

Service Extension Problems in California (82878). James F. Pollard. 2500 w. Elec Wld—Dec. 8, 1917. Electric utility management. Policy in California.

Holland

Het Schakelstation van de Gemeentelijke Electrische Bedrijven te Enschede (83315 B). A. Lengton. 2700 w. Ingenieur—Nov. 17, 1917. Substation interconnected with distribution system in Northern Holland.

Insulation

Apparent Dielectric Strength of Varnished Cambric (82993). A. E. Kennelly and R. J. Wiseman. 2500 w. Elec Wld—Dec. 15, 1917. Investigations of dielectric strength with multiple electrodes; necessity of standardizing size of test electrodes.

Insulators

Factors Affecting Selection of Insulators (83255). A. O. Austin. Ills. 2000 w. Elec Wld—Dec. 29, 1917. Advantages and disadvantages of ground wire, local conditions, etc.

Lines

Construction Details of 66000-Volt Line (83031). Ills. 1500 w. Elec Rev, Chi—Dec. 15, 1917. Unusual conditions in building Wheeling-Moundsville line.

Service Connections

Providing Underground Service Connections Economically (82772). Edward B. Meyer. Ills. 2500 w. Elec Rev, Chi—Dec. 1, 1917.

Wiring

Electric Wiring in Workshops (83089 A). F. Ashton. 1800 w. Mech Wld—Nov. 30, 1917. Serial, 1st part. Suggestions for wiring to meet severe conditions.

Wire Sizes

Methods of Determining Economical Feeder Sizes (82994). P. O. Reyneau. 2500 w. Elec Wld—Dec. 15, 1917. Equations developed and curves plotted to illustrate how most economical size of wire may be determined.

MISCELLANY

Institution of Electrical Engineers

Mr. C. H. Wordingham's Presidential Address to the Institution of Electrical Engineers (82834 A). 3300 w. Elec'n—Nov. 16, 1917. Serial, 1st part. (Abstract.) The present and future work of the Institution.

South Africa

The Association of Municipal Electrical Engineers (Union of South Africa) (82832 A). John Roberts. Presidential address. 3000 w. Elec'n—Nov. 16, 1917. Particularly South African industries and their development. Conditions due to war.

CIVIL ENGINEERING

BRIDGES

Arch

Design and Construction of the Third Avenue, South, Concrete-Steel Arch Bridge, Minneapolis, Minn. (82883 A). Charles F. Bornefeld. Ills. 1000 w. Mun Eng—Dec., 1917. Plan of bridge partly curved having arches of two types. Features of interest.

Bascule

The 186 Foot Bascule Bridge of the C. & N. W. Ry., Over the North Branch of the Chicago River at Deering (83136 B). O. F. Dalstrom, with discussion. Ills. 25 pp. West Soc Engrs, Jl—Sept., 1917. Details of design and construction.

Bridge Architecture

Some Reflections on the Architecture of Bridges (83236). 1700 w. Eng & Con—Dec. 26, 1917. Translated and adapted from Séjourné's "Grandes Voutes," by D. B. Steinman. On the artistic design of bridges.

Long Plate-Girder

New York Central Sets Long Plate Girder in Bridge (83208). Ills. 700 w. Eng News-Rec—Dec. 27, 1917. Complicated West Shore crossing near New Durham, N. J. Two wrecking cranes place 105-ton member, 131½ ft. long.

Metropolis Bridge

Designing the 720-Foot Metropolis Span (83092). Ills. 2500 w. Eng News-Rec—Dec. 20, 1917. Details of span of Ohio River bridge.

Protection

Methods of Protecting Steel Work of Marshall Ave. Bridge, St. Paul, from High Water (83237). Ills. 800 w. Eng & Con—Dec. 26, 1917. Explains conditions and methods of protection used.

War Construction

French Engineers Span Aisne River Under Shell Fire (82724). Robert A. Drake. Ills. 2000 w. Eng News-Rec—Nov. 29, 1917. Details of construction of bridge to replace one destroyed by Germans.

CONSTRUCTION

Building Details

Balcony of Concrete Theater Has Novel Framing (82726). Ills. 1800 w. Eng News-Rec—Nov. 29, 1917. Diagonal beams reduce cantilever moments. Cinder-concrete steps reduce loads.

Steel-Frame Hall Forms Top Story of Concrete Building (82075). Ills. 1000 w. Eng News-Rec—Dec. 13, 1917. Details of structural framing in a reinforced-concrete building in Chicago.

Structural Features of 130 Ft. Tower of New Pennsylvania Freight Station in Chicago (83232). Jos. E. Love. Ills. 900 w. Eng & Con—Dec. 26, 1917. Details of the steel frame, the wind loading and bracing.

Buildings

The New Buildings of Massachusetts Institute of Technology (83267 B). George Elling. Also Student Housing, by H. E. Kebbon. Ills. & 9 plates. 2000 w. Arch For—Dec., 1917. An appreciation of the architecture.

What Is Mill Building Construction? (83203). F. W. Dean. Ills. 4500 w. Eng News-Rec—Dec. 27, 1917. Essentials governing this type of fire-resisting building.

Cantonments

Engineering and Construtcion Features of Cantonments (82955 A). Richard C. Marshall, Jr. Ills. 2000 w. E Cb Phila, Jl—Dec., 1917. Problems met.

Concrete

Concrete Building Has Long-Span Girders and Floor (82730). Ills. 1000 w. Eng News-Rec—Nov. 29, 1917. Building details at Emory University.

Concrete Piles

Betonpalen (83316 B). V. Disselkoen. Ills. 2600 w. Ingenieur—Nov. 24, 1917. Design and application of concrete piling developed by Dutch engineers.

Contract Forms

"Cost Plus" Contract Forms of Fred T. Ley & Co., Inc., Hurley-Mason Co. and Ferro Concrete Construction Co. (83233). 4000 w. Eng & Con—Dec. 26, 1917. Main features of contract forms of these companies.

"Cost Plus" Contract Forms of Stone & Webster (82722). 1500 w. Eng & Con—Nov. 28, 1917. Gives forms used by this concern.

The "Cost Plus" Form of Contract Used on Cantonment work, Including a Schedule of Equipment Rental Rates (82723). 5000 w. Eng & Con—Nov. 28, 1917. Form of government contract.

Factories

Construction of a "Standard" Factory Building for the New York Air Brake Co., at Watertown, N. Y. (82903). Ills. 1000 w. Ry Rev—Dec. 8, 1917. Detailed description.

Unusual Factory Layout Designed to Simplify Operation (82727). Ills. 1200 w. Eng News-Rec—Nov. 29, 1917. A concrete building in Flushing, L. I.

Fireproofing

Fire Proof Building Construction by Cement Gun Process (83235). Ills. 700 w. Eng & Con—Dec. 26, 1917. Work of the Cement Gun Construction Co. of Chicago.

Floors

Chicago Reinforced-Concrete Flat-Slab Ruling Amended (83095). 4000 w. Eng News-Rec—Dec. 20, 1917. New ordnance changes certain features. Also "Why the Chicago Flat-Slab Ruling Was Revised. John Krippner. Ills. Comments.

Housing

Building Frame Houses for Miners As a Contract Job (83205). C. S. Rindsfoos. Ills. 1800 w. Eng News-Rec—Dec. 27, 1917. Methods used in building several hundred for West Virginia Company.

Construction of Industrial Villages for Workmen (82719). Ills. 2000 w. Eng & Con—Nov. 28, 1917. Details of propositions completed and in progress.

Housing and Town Planning Problems After the War (83201 A). 4500 w. Surv'r—Nov. 23, 1917. Interim report of Technical Conference of National Council.

Housing Developments at Lee Park, and Wanamie (82008). F. H. Poggi, Ills. 1800 w. Cl Age—Dec. 8, 1917 Conveniences provided in modern mine houses.

Housing Problems After the War (83058 A). S. D. Adshead. 2000 w. Surv'r—Nov. 30, 1917. Serial, 1st part. First of a course of six lectures being delivered in London.

Industrial Housing Problems (83212 A). Leslie H. Allen. Ills. 3500 w. Iron Age—Dec. 27, 1917. Essentials of dwellings for skilled and unskilled workers. From paper before Natl. Housing Assn., Chicago.

Industrial Buildings

Getting the Greatest Return from Plant Investment (83295 A). Hugh M. Wharton. 1000 w. Ind Man—Jan., 1918. Design of industrial buildings for their effect on quantity, speed and cost of production.

Methods

How Construction Was Speeded Up by Doing Three Jobs at One Time (82856). Ills. 1600 w. Eng News-Rec—Dec. 6, 1917. Increasing the height of three dams on Huntington Lake, Calif., permitted concentration of labor.

Retaining Walls

Notes on Earth Pressures and Retaining Walls (83160 A). Milo S. Ketchum. Ills. 2500 w. Univ Col Jl Eng—Oct., 1917. Supplementary to the writer's The Design of Walls, Bins, and Grain Elevators.

Tunnels

Methods Employed in the Construction of a Siphon Tunnel Under the Milwaukee River (82881 A). A. L. Golinkin. Ills. 2200 w. Mun Eng—Dec., 1917. Details of one of three large, concrete, double-deck siphons included in the new intercepting sewer system.

Wrecking

Fire Aids a Heavy Iron Ball in Wrecking a Modern Reinforced Concrete Building (82720). Jos. E. Love. Ills. 1000 w. Eng & Con—Nov. 28, 1917. Wrecking methods effecting a saving of time and labor.

IRRIGATION AND RECLAMATION

Drainage

The Drainage of Bombay (83153 A). C. Carkeet James. 2500 w. Surv'r—Dec. 7, 1917. Historical review.

Economy

Factors Affecting Economical Use of Water in Irrigation (82072). W. L. Powers, in Bul. of Ore. Experiment Station. 1200 w. Eng & Con—Dec. 12, 1917. Results of experimental studies.

Hydraulic Filling

Five Million Yards Moved to Dam Three Rivers (83207). Ills. 2000 w. Eng News-Rec—Dec. 27, 1917. Account of work at Bridgewater (N. C.). Flow of two watersheds diverted on third.

Philippines

Philippine City's Lowland Raised by Harbor Dredging (83204). W. C. V. Palmer. Ills. 1200 w. Eng News Rec—Dec. 27, 1917. Property in Iloilo developed by selling fill to private owners and by creating public areas.

MATERIALS AND CONSTRUCTION

Cement

Specifications and Methods of Tests for Portland Cement (82942 D). Ills 10 pp. A S C E, Pro—Nov., 1917. Recommended by Joint Conference on Uniform Methods of Tests and Standard Specifications for Cement.

Colloids

The Colloidal State of Matter in its Relation to the Asphalt Industry (82763 A). Clifford Richardson. 4000 w. Met & Chem Eng—Dec. 1, 1917. On the colloids of asphalts and related materals. Read before St. Paul Eng. Soc.

Concrete

Notes on the Uses of Concrete (83179). A. E. Eastman. Ills. 1800 w. Can Engr—Dec. 20, 1917. Advantages and disadvantages of various uses.

Concrete Piles

Discussion of "The History and Present Status of the Concrete Pile Industry" (82900 B). Ills. 45 pp. Bos Soc C E, Jl—Nov., 1917. Discussion of Charles R. Gow's paper.

Conservation

Conservation (83222 A). J. P. Murphy, with discussion. Ills. 35 pp. Cen Ry Cb—Nov. 9, 1917. Calls attention to waste, particularly railway materials.

Cotton Baling

Cotton Baling and Sampling (83073 A). Ills. 800 w. Engr—Nov. 23, 1917. Detailed description of a horizontal cotton baling press, and a machine for taking merchant samples.

Rock Products

The Preparation of Rock Products (83137 B). Raymond W. Dull, with discussion. Ills. 12 pp. West Soc Engrs, Jl—Sept., 1917. Proper methods to use with particular reference to washing and sizing.

Steel Columns

Final Report of the Special Committee on Steel Columns and Struts (83,273 D). Ills. 50 pp. A S C E, Pro—Dec., 1917.

Wood Preservation

Economic Importance of Wood Preservation (82909). Kurt C. Barth. Ills. 2500 w. Eng & Min Jl—Dec. 8, 1917. Steps leading to the successful application of methods.

MEASUREMENT

Beams

Graphical Determination of Beam Deflections (82892). Jesse B. Kommers. Ills. 1500 w. Wis Engr—Nov., 1917. Works out numerical problems for the common cases of beam loading.

Columns

Long Columns Carrying Distributed Loads (83066 A). Arthur Morley. 2000 w. Engng—Nov. 30, 1917. Considers Mr. Koga Kato's method of solution and his results; also explains a method the writer has used.

Floor Test

Test of Reinforced Concrete Floor in the Western Newspaper Union Building, Chicago (82718). Jos. E. Love. Ills. 1200 w. Eng & Con—Nov. 28, 1917. Account of test-covering three weeks and costing about $3,000.

"Mass"

The Much-Abused Term "Mass" in Engineering Calculations (82957 A). Carl Hering. 2500 w. E Cb Phila—Dec., 1917. Explanatory.

Shear Diagram

Shear Diagram for Bent-up Bars (82,721). Frank S. Bailey. 500 w. Eng & Con—Nov. 28, 1917. Simplified method of determining the value.

Surveying

Photo-Surveying (82958 A). R. S. Swinton. Ills. 2500 w. Mich Tech—Dec., 1917. Methods; instruments; practice, etc.

Tunnels

Lines and Grades in Tunnels of Small Diameter (82901 B). Henry B. Pratt. Ills. 900 w. Bos Soc C E, Jl—Nov., 1917. Method devised by which the instrument could be attached to the roof of the tunnel in an inverted position.

Survey Methods Used on the Wilson Avenue Tunnel, Chicago, Ill. (83138 B). H. W. Clausen. Ills & Plates. 12 pp. West Soc Engrs, Jl—Sept., 1917. Methods described.

Weirs

Autographic Flow Curve for Any Weir (83223 A). Irving Porter Church. 1500 w. Corn C E—Nov. 19, 1917. Describes and demonstrates the design of an automatic appliance devised by the writer.

The Effect on Orifice and Weir Flow of Slight Roundings of the Upstream Edge (83224 A). Jacob O. Jones. Ills. 3000 w. Corn C E—Nov., 1917. Details of experimental investigations showing the effect on weir flow is comparatively small.

MUNICIPAL

Activated Sludge

Some Conclusions Reached at Milwaukee on Treatment of Sewage by Activated Sludge Process (82884 A). 3500 w. Mun Eng—Dec., 1917. Results of observations and studies of the operation of the sewage testing station.

Garbage

The Effect of the War on the Production of Garbage and Methods of Disposal (82969). From paper by I. S. Osborn. 2000 w. Eng & Con—Dec. 12, 1917. Considers decrease in quantity and quality and tendency to change methods of disposal.

Public Works

Porthcawl and Its Public Works (83,229 N). Frederick Hatcher, with discussion. Map & Ills. 24 pp. Instn Mun Cnty Engrs, Jl—Nov., 1917. Drainage, water supply, sea wall improvement, etc. in Wales.

Refuse

Recommended Methods for the Collection and Disposal of Refuse in Louisville, Ky. (82885 A). Samuel A. Greeley. Ills. 3000 w. Mun Eng—Dec., 1917. Results of field inspection. Treatment of garbage, ashes, rubbish, tins, and mixed refuse.

Sewage

Copper in Sewage at the New Haven Sewage Experiment Station (82787 B). F. W. Mohlman. Ills. 2500 w. Jl Ind & Eng Chem—Dec., 1917. Reasons for investigations; details of plant and processes, etc.

Street Openings

Method and Cost of Using Compressed Air Equipment in Making Street Openings (82882). Ills. 1000 w. Mun Eng—Dec., 1917. Results obtained by applying air-tools.

ROADS AND PAVEMENTS

Administration

The New Kansas State Highway Administration Law (82849). W. S. Gearhart. 3000 w. Eng & Con—Dec. 5, 1917. Paper before the Oklahoma Eng. Soc. outlining the new system.

Concrete

Building State-Aid Concrete Road Near Grand Rapids (82728). 1500 w. Eng News-Rec—Nov. 29, 1917. Methods of construction.

Construction Costs

Reducing Construction Costs by Increased Efficiency (83040). W. Huber. 5000 w. Br Rds & Sts—Dec., 1917. Suggestions for road construction.

Gravel

Two Methods of Maintaining Gravel Roads in Maine (83206). Ills. 1200 w. Eng News-Rec—Dec. 27, 1917. Describes methods. Chief reliance is placed on annual tar treatment.

Highways

Intense Study of Highways Forced by Circumstances (83094). 2000 w. Eng News-Rec—Dec. 20, 1917. Changes made necessary by heavier and speedier traffic. New types.

Military and Other Highways in War Time (82974). William D. Sohier. 6000 w. Eng News-Rec—Dec. 13, 1917. Address at Richmond, Va., before Am. Assn. of State Highway Officials.

Missouri Surveys

Instructions of Missouri State Highway Department for Making State Road Surveys and Plans (82850). 2200 w. Eng & Con—Dec. 5, 1917. Recently issued regulations.

Pavements

Concentrated Pressure Causes Many Pavement Failures (82858). A. H. Hinkle. Ills. 1000 w. Eng News-Rec—Dec. 6, 1917. Brick surfaces particularly suffer.

The Selection of a Pavement (82893). Louis C. Rockett. 2500 w. Wis Engr—Nov., 1917. Requisites of good pavements; life, cost, traffic, etc.

Reconstruction

Reconstruction of the Eaton "Model Highway" (82749). Ills. 2500 w. Can Engr—Nov. 29, 1917. Made necessary by change in traffic conditions.

Road Act

Good Progress Made in Operation of Federal-Aid Road Act (83093). 2500 w. Eng News-Rec—Dec. 20, 1917. Address of Logan Waller Page before Am. Assn. of State Highway Officials.

Road Materials

Final Report of the Special Committee on Materials for Road Construction and on Standards for Their Test and Use (83272 D). 30 pp. A S C E, Pro—Dec., 1917.

Transportation Problems

Improved Highways and Waterways as War Necessities, as Viewed by General Goethals and Major-General Black, Chief of Engineers, United States Army (83119). 3500 w. Mfrs' Rec—Dec. 20, 1917. Statements of two eminent engineers.

Wood Block

Creosoted Block Can Be Laid on Hardened Pitch Cheaper Than on Dry Mortar (83096). Walter Buehler. Ills. 2000 w. Eng News-Rec—Dec. 20, 1917. Details of construction.

WATER SUPPLY

Atmospheric Pollution

Atmospheric Pollution and the Impurities of Rain-Water (83072 A). John B. C. Kershaw. 2500 w. Engr—Nov. 23, 1917. Results of two years' observations in twelve English towns and cities.

Cantonments

Construction Features of Water Supply System and Sewerage Works for the Camp Custer Cantonment (82968). Ills. 3500 w. Eng & Con—Dec. 12, 1917. Details of this work at a camp in Michigan.

Dams

Calaveras Hydraulic Fill Earth Dam (83158 A). G. A. Elliott. Ills. 3000 w. Univ Col Jl Eng—Oct., 1917. Design, construction, and related matters.

La Loutre Dam Across St. Maurice River Completed (83263). Charles Luscombe. Ills. 2500 w. Can Engr—Dec. 27, 1917. Transportation difficulties, construction, etc.

Laboratories

American Water Works Laboratories (82970). Abstract of paper by J. J. Hinman, Jr., before Am W-Works Assn. 2500 w. Eng & Con—Dec. 12, 1917. Summary of results of investigation.

Manganese

Manganese in the Water Supply of Pierre, South Dakota (82860). J. W. Sale. Ills. 1200 w. Eng News-Rec—Dec. 6, 1917. Two-inch mains badly clogged. Aeration and milk of lime treatments prove effective in laboratory tests.

Pipe Lines

Air Tanks on Pipe Lines (82944 D). 9 pp. A S C E, Pro—Nov., 1917. Continued discussion of Minton M. Warren's paper.

Overland Pipe System, Ottawa Waterworks (83178). L. McLaren Hunter. Ills. 1000 w. Can Engr—Dec. 20, 1917. Details of the system and its structures.

Potable Water

La Sterilizzazione dell' Acqua a Scopo Potabile (83303 B). 1200 w. Monitore Tecnico—Oct. 30, 1917. Water sterilization plants now in use in Europe and South America.

Purification

Electrically Operated Purification Plant at Great Falls, Mont. (83032). Ills. 1200 w. Elec Rev, Chi—Dec. 15, 1917. Details of equipment and operation.

Ultra-Violet Rays Finish Treatment of Henderson Water-Supply (82729). A. T. Smith. Ills. 700 w. Eng News-Rec—Nov. 29, 1917. Sedimentation, mechanical filter, and ultra-violet purification plant.

Rates

The Basis of Water Charges in Urban Areas from the Point of View of Common Utility (83057 A). E. C. Rodda. Extracts from paper before Munic. W.-Wks. Assn., Birmingham. 2500 w Surv'r—Nov. 30, 1917. Rate regulation.

Records

Pumping Station Cost and Efficiency Records (82748). Mark Wolf. 2000 w. Natl Engr—Dec., 1917. System used for thirty-one pumping plants in Brooklyn.

Supply

Water Supply and Water Power (82746). R. W. Lewis. 2000 w. Natl Engr—Dec., 1917. Estimates and elements determining supply.

Tunnel Lining

Design and Construction Methods for Copper Lining for City Tunnel of New York Catskill Aqueduct (82971). 4000 w. Eng & Con—Dec. 12, 1917. Information from last annual report of N. Y. City Board of Water Supply.

Water Hammer

Pulsations in Pipe Lines, as Shown by Some Recent Tests (83274 D). 10 pp. A S C E, Pro—Dec., 1917. Discussion of H. C. Vensano's paper.

Water Works

The Ystradfellte Water Works (83,230 N). D. M. Davies, with discussion. Maps & Ills. 22 pp. Instn Mun & Cnty Engrs, Jl—Nov., 1917. Sources of supply, works, cost, etc.

WATERWAYS AND HARBORS

Barge Canal

New York's New Canal Ready in 1918 (82709 A). M. E. Mutchler. Ills. & Map. 2000 w. Mar Rev—Dec., 1917. Serial, 1st part. Information concerning the Barge Canal system and the region it will serve.

Canals

Mid-Scotland Ship Canal Schemes (83075 A). Maps. 3000 w. Engr—Nov. 30, 1917. History of the project and the proposed routes.

Alimentazione Idrica di un Canale Navigabile da Savona a Torino (83,301 B). Ills. 3000 w. Monitore Tecnico—Oct. 20, 1917. System of internal waterways for Italy. Profile and sections of proposed canals.

The Cape Cod Canal (82945 D). 13 pp. A S C E, Pro—Nov., 1917. Discussion of William Barclay Parsons' paper.

Het Kanaal naar Twenthe (83311 B). D. A. Van Heyst. Ills. Colored Map. 5200 w. Ingenieur—Oct. 13, 1917. Map and general plans for a new system of canals in Holland.

Dredges

The Three 15-Cubic Yard Dipper Dredges, Gamboa, Paraiso, and Cascodas, as Supplied and Used on the Panama Canal (82943 D). 20 pp. A S C E, Pro—Nov., 1917. Continued discussion of paper by Ray W. Berdeau, Jr.

Harbors

Harbor Improvements for Imperial Trade (83132 A). 1500 w. Engng—Dec. 7, 1917. Requisites of British ports. Lord D'Abernon's work.

Louisiana Waters

Louisiana Waters, and Their Industrial Possibilities (83014 A). Welman Bradford, with discussion. Map. 20 pp. La Eng Soc, Pro—Dec., 1917. Possibilities and proposed development.

Surface Waters

Ice Diversion, Hydraulic Models, and Hydraulic Similarity (83270 D). Benjamin F. Groat. Ills. 3000 w. A S C E, Pro—Dec., 1917. New method of diverting surface water and all floating materials to prevent jams in canals and rivers.

Water Level

Der Watersnood van 1916 en Zijn Gevolgen (83312 B). C. J. A. Reigersman. Ills. 14,000 w. Serial, 1st part. Ingenieur—Oct. 20, 1917. Discussion of flood conditions and mean water level in Dutch interior waterways. Engineering work, surveys, etc.

See also TRANSPORTATION PROBLEMS under *Roads and Pavements.*

MISCELLANY

A S C E

The Activities of the American Society of Civil Engineers During the Past Twenty-five Years (83271 D). Charles Warren Hunt. Ills. 75 pp. A S C E, Pro—Dec., 1917. Review of the most interesting accomplishments.

China

The Commercial Development of Engineering in China (83109 A). S. W. B. McGregor. Map. 2000 w. Elec'n—Dec. 7, 1917. Serial, 1st part. Changes in progress and modern improvements being introduced.

Engineers

Awakening Recognition of the Engineer (83209). Fraser S. Keith. 1700 w. Eng News-Rec—Dec. 27, 1917. Extracts from address before Can. Soc. of Civ. Engrs. The status and future of the engineering profession.

Land Clearing

Method and Cost of Clearing Cut Over Land With Powder (83130). Ills. 2500 w. Eng & Con—Dec. 19, 1917. Results obtained by the use of blasting powder in Idaho.

Method of Burning Stumps in Place in Land Clearing (83140). From paper by I. D. Charlton. 1500 w. Eng & Con—Dec. 19, 1917. Methods that have been tried in Washington.

Tropics

Engineering in the Tropics (83150 A). Leslie E. Miner. Map & Ills. 3000 w. Univ Col Jl Eng—Oct., 1917. Experiences in building the Madeira-Mamoré Railway.

MARINE AND NAVAL ENGINEERING

Address

Presidential Address of Mr. Alexander Cleghorn (82932 N). 40 pp. Instn E & S Scot, Trans—Nov., 1917. Deals mainly with recent progress in marine engineering and steps taken to establish an Association in Scotland for scientific and industrial research.

Concrete Boats

Sulle Navi in Cemento Armato (83,304 B). Ills. 1200 w. L'Industria—Nov. 21, 1917. Design and construction of reinforced concrete vessel 98 ft. long.

Diesel Engines

Notes on Operation of Submarine Diesel Engines (83020 F). F. C. Sherman. 4000 w. Am Soc Nav Engrs, Jl—Nov., 1917. Results of four years' experience in operating engines of the two-cycle Neurnberg type.

Evaporator

Test of Schutte and Koerting Evaporator (83021 F). M C. Stuart. Ills. 3000 w. Am Soc Nav Engrs, Jr—Nov., 1917. Data regarding evaporator performance developed during a recent test.

Freighters

New Southern Pacific Freighters (82818 A). Ills. Supplement. 2000 w. Int Mar Eng—Dec., 1917 Single screw vessels built at Newport News. Design, machinery and equipment

Merchant Marine

Our Merchant Marine, Present and Future (83228 B) Irving L. Evans, with discussion. 12 pp. Cleve Eng Soc, Jl—Nov., 1917. The manning of the merchant marine. How it may be accomplished. The question of officers.

New Ship

Ketels en Hulpwertuigen van de Nieuwe Vrachtschepen "Nederland" (83313 B). J. F DuC. Muller. Ills. 5200 w. Ingenieur—Nov. 3, 1917. Boilers and engines of a recently constructed Dutch ship.

Propelling Engines

Standard Propelling Engines for British Standard Ships (83068 A). Ills. & Plate. 1200 w. Engng—Nov. 30, 1917. Descriptive.

Salving

Salved After Two Years on Rocks (82708 A). Ills. 700 w. Story of the salving of "Western Star" in Georgian bay, Lake Huron.

Screw Propellers

Balancing of Rotating Masses, With Special Reference to Screw Propellers (83167 A). J. J. King-Salter. Ills. 2000 w. Aust Min Stand—Nov. 22, 1917. Serial, 1st part. Read before the Eng. Assn. of N. S. W. Reviews causes of the want of running balances in rotating masses and means of correcting.

Shipbuilding

Concrete Shipbuilding Firmly Established by Norwegian Firms (82973). Ills. 2000 w. Eng News-Rec—Dec. 13, 1917. Account of work accomplished in past 18 months.

Notes on Shipbuilding (83013 A). F. J. French, with discussion. 23 pp. La Eng Soc, Pro—Dec., 1917. Problems to be solved by the prospective shipbuilder.

Progress in Reinforced Concrete Ship Building (83234). Ills. 1200 w. Eng & Con—Dec. 26, 1917. Work in progress by a number of companies.

The Men Who Will Build the Ships. How the Department of Labor Will Get Them (82817 A). C. T. Clayton. 2500 w. Int Mar Eng—Dec., 1917. Methods the U. S. Government will use to secure 125,000 shipyard workers.

Steering

Notes on Steering Gears, Rudders, Torque, and Steering Engine Performance (83169 A). Lucian E. Underwood. Ills. 3500 w. Am Soc Mar Dftn, Jl—Oct., 1917. Methods of control and operation.

Unloading

A New and Novel System of Vessel Unloading (82869). Ills. 1500 w. Ry Age Gaz—Dec. 7, 1917. Automatic car loading machine with electric weighing devices on an open pier.

Valve Gears

Balance Cylinders vs. Lovekin Assistant Cylinders for Valve Gears (83,171 A). O. J. Peterson. Ills. 1000 w. Am Soc Mar Dftn Jl—Oct., 1917. Comparison of the performances.

Vent Pipes

Determining the Size of Air Escape or Vent Pipes (83170 A). Samuel B. Crosby. 800 w. Am Soc Mar Dftn, Jl—Oct., 1917. Outlines method.

MINING AND METALLURGY

BASE METALLURGY

Copper

The Arbouin Copper Mines at Cardross (82813 N). Lionel C Ball. Ills. 3500 w. Qnsd Gov Min Jl—Oct., 1915. Serial, 1st part. History, geology, ore deposits, mineralogy, mining, and transport.

Lead

The Lead Situation in Canada (82,979 N). Alfred Stansfield. 1500 w. Can Min Inst, Bul—Dec., 1917. Explains the situation, considering it under five stated heads.

Metallurgy

Metallurgy and the War (83225 A). 3000 w. Pahasapa Qr—Dec., 1917. The development of copper.

Missouri

The Mining District of Joplin and Southeast Missouri (83188). H. W. Kitson. Ills. & Map. 5000 w. Eng & Min Jl—Dec. 22, 1917. Serial, 1st part. Geological outline of the ore deposits in the zinc and lead districts.

Reverberatory Practice

Development of Reverberatory Practice at Copper Cliff, Ont (83190). Charles F. Mason. 1200 w. Eng & Min Jl—Dec. 22, 1917. Describes development of side-wall charging, and the changes in furnace construction required.

Tin

Tin Dredging in Portugal (83279). Frederick W. Foote and Rastus S. Ransom, Jr. Ills. 1000 w. Eng & Min Jl—Dec. 29, 1917. American successful operation on the east side of Sierra Estrella mountains. Dredge operated by electricity.

Zinc

Losses in Zinc Metallurgy (82792). 1200 w. Eng & Min Jl—Dec. 1, 1917. Sources of waste, methods of prevention and suggestion for improvements.

Zinc Ore

Utilization of the Sulphur Contents of Zinc Ore (82789 A). H. M. Ridge. Ills. 4000 w. Aust Min Stand—Oct. 25, 1917. Read before the London Sec. of Soc. of Chem. Ind. This supply of sulphuric acid.

COAL AND COKE

Anthracite

Methods of Mining in the Pennsylvania Anthracite Field (83110 N). Hugh M. Crankshaw, with discussion. Ills. 6000 w. Instn Min Engrs, Trans—Nov., 1917. Methods of working to meet conditions.

Canada

The Production of Coal and Coke in Canada During the Calendar Year 1916 (82890 N). John McLeish. 46 pp. Can Dept Mines—No. 465. Statistics.

Carbon

X-Rays and the Structure of Crystallized and Amorphous Carbon (83128 A). 1500 w. Engng—Dec. 7, 1917. Examinations tending to show only two modifications of carbon instead of three.

Coal

The Coal Operators of America Defended (82989). A. W. Dean. 1500 w. Mfrs' Rec—Dec. 13, 1917. Statement on the proposed pooling plan.

Coal Age

The Forests of the Coal Age (83111 N). D. H. Scott, with discussion. Ills. 30 pp. Instn Min Engrs, Trans—Nov., 1917. From the viewpoint of the botanist.

Coal Breaker

A Modern Anthracite Preparation Plant (83141). D. C. Ashmead. Ills. 2000 w. Cl Age—Dec. 22, 1917. Detailed description of the Loomis breaker near Nanticoke, Penn.

Coalfields

Note on the Correlation of Certain Seams in the Yorkshire Coalfield (83,112 N). Percy Fry Kendall, with discussion. Plate. 3500 w. Instn Min Engrs, Trans—Nov., 1917. Examines existing information.

The Areas and Deposition of the Coalfields of Western Europe (83113 N). G. Blake Walker, with discussion. 2 plates. 15 pp. Instn Min Engrs, Trans—Nov., 1917. Reviews the history of the Carboniferous Period.

Coal Seams

On the Splitting of Coal Seams by Partings of Dirt (82825 A). P. F. Kendall, with discussion. Read before the Midland Inst. of Min., Civ. & Mech. Engrs. 7000 w. Colly Gdn—Nov. 9, 1917. Serial, 1st part. The present article deals with splits that rejoin.

Coal Situation

The Coal Situation—A National Menace (83146). J. D. A. Morrow, with editorial. 2000 w. Ry Age Gaz—Dec. 21, 1917. A letter replying to an earlier editorial, with reply.

War's Influence on the Coal Situation (83038). Charles H. Bromley. 3000 w. Power—Dec. 18, 1917. Analysis, particularly as related to its use in the industries.

Coal Waste

Preventable Waste of Coal in the United States (82916 A). David Moffat Myers. 8 pp. A S M E—Dec., 1917. Largely through faulty operation of boiler plants.

Coke

By-Product Coke and Coking Operations (82915 A). C. J. Ramsburg and F. W. Sperr, Jr. Ills. 32 pp. A S M E—Dec., 1917. Account of the generally accepted theory. Methods employed.

The Determination of Moisture in Coke (82889). A. C. Fieldner and W. A. Selvig. 2500 w U S Bur Mines—Tech. paper 148. Investigations to determine the most rapid and simple method for use in purchasing coke.

Coke Handling

Coke Handling Plant at Warrington Gasworks (82840 A). Ills. 1500 w. Engr—Nov. 16, 1917. An example of coke handling by telpher.

Coking

Recent Developments in By-Product Coking (83154 A). George Blake Walker. 2500 w. Jr & Cl Trds Rev—Dec. 7, 1917. Abstract of paper before Instn of Civ. Engrs. Methods of charging ovens, recovering of by-products, etc.

Deep Boring

Deep Borings in Yorkshire, Kent and Sussex (83060 A). 2500 w. Colly Gdn—Nov. 23, 1917. Particulars of several deep borings for coal investigated during the year.

Electrical Apparatus

Drying Colliery Electrical Apparatus (83059 A). L. Fokes. Diagrams. 2500 w. Colly Gdn—Nov. 23, 1917. Suggests methods.

Points on the Electrification of Collieries (83062 A). A. C. Nelson. Ills. 6000 w. Colly Gdn—Nov. 30, 1917. Favors the central station supply and gives applications.

France

The Coal Problem in France (82,826 A). 1500 w. Colly Gdn—Nov. 9, 1917. Information from an article by R. Pinot showing the shortage in coal production.

Fuel

The Fuel Administration—Its Task (83254). H. A. Garfield. 3500 w. Cl Age—Dec. 29, 1917. What the fuel administration is organized to do.

Methods

Coal Conveyor in a Thin Bed (82,752). D. C. Ashmead. Ills. 1500 w. Cl Age—Dec. 1, 1917. Longwall method adapted, using face conveyors.

Mining Institute

Coal Mining Institute of America Meets (82992). R. Dawson Hall. 1800 w. Cl Age—Dec. 15, 1917. Serial, 1st part. First instalment of an account of important features of the meeting.

Power Generation

Economical Generation of Thermal Power at Coal Mines (82751). John B. C. Kershaw. 3500 w. Cl Age—Dec. 1, 1917. Serial, 1st part. Deals with the waste fuels at mines and their utilization.

Pulverized Coal

General Utilization of Pulverized Coal (83226 B). Henry G. Barnhurst, with discussion. 19 pp. Cleve Eng Soc, Jl—Nov., 1917. Facts concerning the growth and development of the use.

General Utilization of Pulverized Coal (82956 A). H. G. Barnhurst. Ills. 2000 w. E Cb Phila, Jl—Dec., 1917. Development and industrial applications.

Stripping

Anthracite Coal Stripping (83253). Thomas F. Kennedy. 1300 w. Cl Age—Dec. 29, 1917. Serial, 1st part. Method of prospecting a stripping area.

Economy of Mining Coal by Stripping (83142). E. C. Drum. Ills. 1000 w. Cl Age—Dec. 22, 1917. Methods and costs.

Thin Seams

The Thin-Mine Problem (83117 N). H. O. Dixon, with discussion. 2500 w. Instn Min Engrs, Trans—Nov., 1917. Methods of working and results from a 19-inch seam of steam coal.

GEOLOGY

Applied Geology

Engineering Applications of Geology (82902). W. J. Dick. Ills. 3000 w. Can Engr—Dec. 6, 1917. Foundation conditions in Canadian cities. Interpretation of geological data with reference to engineering Read before Can. Soc. C. E.

Goldfields

The South Rand Goldfield—Part II (83114 N). A. R. Sawyer, with discussion. 4000 w. Instn Min Engrs, Trans—Nov., 1917. Information concerning this field, its stratification, etc.

Nickel

Some Quantitative Measurements of Minerals of the Nickel-Eruptive at Sudbury (83046 B). Myron A. Dresser. Ills. 17 pp. Ec-Geol—Oct.-Nov., 1917. Study and conclusions.

Ore Deposits

Classification of Ore Deposits Based Upon Origin, Deformation, and Enrichment (83050 B). T. T. Quirke. Chart. 1000 w. Ec-Geol—Oct.-Nov., 1917. Aid in teaching economic geology.

Potash

Geology of the Glass House Mountains and of Potash Salts (83231 N). H. I. Jensen. Ills. 1200 w. Qnsd Gov Min Jl—Nov. 15, 1917. Potash from trachytic rocks of Queensland.

Refractories

Geological Research on Refractories During 1916 (82816 A). A. Strahan. 5000 w. Colly Gdn—Nov. 16, 1917. Summary of progress of the field work of the Geological Survey.

IRON AND STEEL

Blast Furnaces

Blast-Furnace Breakouts, Explosions, and Slips, and Methods of Prevention (83007 A). F. H. Willcox. Ills. 267 pp. U S Bur Mines—Bul 130. Study of their dangers, occurrence, and methods of preventing.

Canada

Iron Ore Occurrences in Canada (82886 N). E. Lindeman and L. L. Bolton. Maps &Ills. 65 pp. Can Dept Mines—No. 217. Descriptions of principal iron ore mines.

Electric Furnaces

The Frst Electric Steel-Melting Furnace in South Africa (83216 N). W. Buchanan and George H. Stanley, with discussion. Ils. 37 pp. So Af Inst Elec Engrs, Trans—Sept., 1917. Details of furnace and plant and the operation and results.

Electricity

Electricity as a Fuel Saver in the Iron and Steel Industry (83082 A). A. H. Marshall. 4500 w. Ir & Cl Trds Rev—Nov. 30, 1917. Abstract of presidential address before Newcastle Local Sec of the I. E. E.

Grain Growth

Grain-Growth in Deformed and Annealed Low-Carbon Steel (82066 N). Ralph H. Sherry, with discussion. Ills. 20 pp. Faraday Soc, Trans—June, 1917. Investigates the phenomenon of coarse crystallization.

Iron Founding

Links in the History of Engineering (83133 A). Rhys Jenkins. 1200 w. Engr—Dec. 7, 1917. Serial, 1st part. The beginning of iron founding in England.

Liquid Steel

The Determination of the Temperature of Liquid Steel Under Industrial Conditions (82841 A). Cosmo Johns. 3000 w. Ir & Cl Trds Rev—Nov. 16, 1917. The use of pyrometers.

Ore Deposits

Manganiferous Iron Ore Occurrences (83283). Joseph B. Umpleby. 1000 w. Eng & Min Jl—Dec. 29, 1917. Two deposits in Colorado recently developed.

Pickling

The Electrolytic Pickling of Steel (83004 A). M. DeKay Thompson and F. W. Dodson. 1000 w. Met & Chem Eng—Dec. 15, 1917. Results of experiments on block sheet iron and a comparison of electrolytic with chemical pickling.

Refining

Refining of Steel by Electric Furnace Process (82905) C. A Tupper Ills. 1500 w. Elec Rev, Chi—Dec. 8, 1917. Details and advantages of electric steel smelting and refining.

Regulator

A Volume Regulator for Blast Furnace Engines (82917 A). L. C. Loewenstein. Ills. 40 pp. A S M E—Dec 1917. The problem of regulating the air supply to a blast furnace

Tungsten Works

Tungsten and High-Speed Steel (83,067 A). 3500 w. Engng—Nov. 30, 1917 Describes processes of making high-speed steel by alloying the tungsten with iron.

MINE OPERATION

Bucket Elevators

Design and Construction of Bucket Elevators (83281). Roy Reddie. Ills. 7000 w. Eng & Min Jl—Dec. 29, 1917. The belt-bucket type of elevator, when properly designed, gives an efficient and economical means of elevating wet or dry crushed ore.

Floor Sampling

Sampling of Mine Floors (83280). Albert G. Wolf. 2000 w. Eng & Min Jl—Dec. 29, 1917. Methods for diverting the flow of water in drifts where floor samples are to be taken.

Haulage Roads

Rounding Curves on Haulage Roads (83155 A). William Dakin, with discussion. Ills. 8000 w. Ir & Cl Trds Rev—Dec. 7, 1917. Read before Natl. Assn. of Colly. Mgrs. Problems of endless rope haulage.

Mine Cars

An Automatic Drop-Bottom Mine Car (83074 A). Ills. 1200 w. Engr—Nov. 23, 1917. Detailed description of the Griffith tub, made at Knoxville, Tenn.

Mine Management

The Commonsense of Mine Management (82911). Henry M. Adkinson. 3000 w. Eng & Min Jl—Dec. 8, 1917. Modern business methods as applied.

Mine Telephones

The Operation of Magneto Telephones in Series to Avoid Gas Ignition in Mines (82842 A). L. Fokes. Ills. 1200 w. Ir & Cl Trds Rev—Nov. 16, 1917. Mining telephones, their operation and installation.

Mining Industry

The Saloon Evil in the Mining Industry (82991). 2500 w. Cl Age—Dec. 15, 1917. Effect on coal production.

Mining Methods

Squeeze in the Maxwell Shaft (82,990). D. C. Ashmead. Ills. 1800 w. Cl Age—Dec. 15, 1917. Details of plan for reconstructing the timbering.

Mining Methods at Chapin Mine, Michigan (82912). W. C. Gordon. Read at meeting of L. Superior Min. Inst. 4000 w. Eng & Min Jl—Dec. 8, 1917. Combined top-slicing and sub-level caving.

Power Plants

The Logan, West Virginia, Power Plant (83037). Ills. 1800 w. Power—Dec. 18, 1917. An up-to-date small capacity plant furnishing power and light to mines.

Tunnels

Driving Operations of the Spiro Tunnel of the Silver King Consolidated (83034). Murray Schick. Ills. 1000 w. Eng & Min Jl—Dec. 15, 1917. Account of the 14,000 ft. drainage tunnel in Utah.

MINES AND DISTRICTS

California

California Mineral Production for 1916 (83221 N). Walter W. Bradley. With county maps and Ills. 170 pp Calif State Min'g Bur, Bul 74—Aug., 1917. Statistics.

Kalgoorlie

The Effect of the Cost of Water on Metallurgical Progress at Kalgoorlie (82812 N). Thomas B. Stevens. 1200 w. Cham Mines W Aust, Mthly Jl—Aug. 31, 1917. Ways in which the cost of water affects the profits.

Mackenzie River

The Mackenzie River Basin (82038). Gerald M. Ponton. Ills. 2500 w. Can Min Jl—Dec. 1, 1917. The Canadian northwest, its possibilities, resources, etc.

Russia

Mining in Russia After the War (82,-810 A). Eugene De Houtpick. 2000 w. Aust Min Stand—Nov. 1, 1917. Serial, 1st part. Social and economic aspects due to the war and the revolution.

Spitzbergen

Spitzbergen and Its Resources (83,-120 A). 1200 w. Map. Engrg—Dec. 7, 1917. Information concerning the coal deposits.

Utah

Mining in Utah (83182). Benjamin F. Tibby. Ills. 2500 w. Min & Sci Pr.—Dec. 22, 1917. Coal, oil, metal mines, potash, etc.

MINOR MINERALS

Bauxite

Bauxite in the South (83238). James M. Hill. 4000 w. Mfrs' Rec—Dec. 27, 1917. Occurrence and character, methods of mining, etc.

California

Manganese and Chromium (83104 N). E. S. Boalich. Ills. 22 pp. Calif State Min Bur—Sept., 1917. Preliminary report on deposits in California and their extent.

Chromium

Chromium, Its Occurrence and Mining (82910). Excerpt from an article by Heinrich Ries. 1800 w. Eng & Min Jl—Dec. 8, 1917. Sources of domestic and foreign supply, with table of comparative analyses of chromite ores.

Gypsum

The Gypsum and Natural Whiting Deposits of Yorke Penninsula, South Australia (83249 N). 1200 w. Chem Eng & Min Rev—Nov., 1917. The deposits and workings.

Manganese

Utilization of Manganese Ores in Sweden (83001 A). Joh. Harden. 3500 w. Met & Chem Eng—Dec. 15, 1917. Methods of smelting, furnace types, methods of using the alloy, etc.

Utilizing Domestic Manganese Supplies (82734 A). Edmund Newton. 2500 w. Iron Age—Nov. 29, 1917. Conserving manganese in basic open-hearth bath metal.

Molybdenite

Molybdenite at Falcon Lake, Manitoba (82936). J. S. De Lury. Map. 1500 w. Can Min Jl—Dec. 1, 1917. Information concerning the occurrences.

Nickel

Nickel (83262). E. P. Mathewson. Address before Roy. Can. Inst., Toronto. 2500 w. Can Min Jl—Dec. 15, 1917. Canada as a producer, its extraction, uses, etc.

Potash

The Nebraska Potash Industry (82,-990 A). Ernest E. Thum. Ills. 4500 w. Met & Chem Eng—Dec. 15, 1917. Describes the deposits and their development.

Pyrite

Pyrite in Northern New York (82,-791). D. H. Newland. 1200 w. Eng & Min Jl—Dec. 1, 1917. Low-grade deposits of considerable extent in the Adirondacks.

OIL AND GAS

British Isles

Oil Prospects of the British Isles (83061 A). W. H. Dalton. Read before Inst. of Petroleum Tech. 2500 w. Colly Gdn—Nov. 23, 1917. Does not think there are deposits of commercial value.

Gasoline

Solving the Gasoline Problem (83,-173 B). W. P. Deppé, with discussion. Charts. 9500 w. S A E, Jl—Dec., 1917. Methods of increasing the quantity and of avoiding waste.

Oil

The Search for New Oil Pools in the United States (83485). Dorsey Hager. Map. 1800 w. Eng & Min Jl—Jan. 5, 1918. Reviews possibilities in various states.

Kansas-Oklahoma Oil Production Worth Million Dollars a Day (82732). C. M. Sarchet. 1200 w. Mfrs' Rec—Nov. 29, 1917. Production and demand.

Oil Fields

The Healdton Oil Field, Oklahoma (83049 B). Sidney Powers. 4000 w. Ec-Geol—Oct.-Nov., 1917. Geologic structure, character of oil, development, etc.

Oil Refining

The Trumble Refining Process (82,-913 A). N. W. Thompson. Ills. 13 pp. A S M E—Dec., 1917. Details of the process with description of an actual plant. Chief advantage is the conservation of heat.

Petroleum

Petroleum and Its Products (82717 B). Van H. Manning. 6500 w. S A E, Jl—Nov., 1917. Limitations of supply, methods of producing gasoline, production, waste, etc.

The Petroleum Geology of the Isthmus of Tehuantepec (83047 B). Burton Hartley. Map. 2000 w. Ec-Geol—Oct.-Nov., 1917. Géology, deposits, structural features, etc.

Sperm Oils

Some Data on Sperm Oils Used for Burning Purposes (82788 B). Abraham G. Blakeley and Edmund A. Reilly. 1000 w. Jl Ind & Eng Chem—Dec., 1917. Results of tests made of oil used in miners' safety lamps.

ORE DRESSING

Concentration Tests

Comparative Concentration Tests on Wood and Fluted Glass Surfaces at Porco, Bolivia (82931 N). Harold A. Lewis. 12 pp. Instn Min & Met, Bul 158—Nov. 8, 1917. Account of trials made and results.

Slime Treatment on Cornish Frames: with Particular Reference to the Effect of Surface (82930 N). S. J. Truscott. Ills. 68 pp. Instn Min & Met, Bul 158—No . 8, 1917. Report of tests, the apparatus and methods of testing, etc.

Cyaniding

Charcoal as a Precipitant of Gold from Its Cyanide Solution (83217 N). H. R. Edmands. Ills. 2200 w. Cham Mines W Aust, Mthly Jl—Sept., 1917. Features of the process, method of working, etc.

Cyaniding a Small Gold-Tailings Dump (83035). A. W. Allen. Ills. 6500 w. Eng & Min Jl—Dec. 15, 1917. Describes plant suitable for man with little capital.

Flotation

A Flotation Patent (83183). Ills. 2000 w. Min & Sci Pr—Dec. 22, 1917 Walter A. Scott's method of introducing oils in form of vapor with the air.

Control of Emulsions in Flotation (83028). Alfred Schwarz. 1200 w. Min & Sci Pr—Dec. 15, 1917. Editorial letter. Colloids will sometimes perform the office of oils in flotation.

Flotation at Cobalt, Ontario (82952) W. E. Simpson. Also editorial. Ills. 4500 w. Min & Sci Pr—Dec. 8, 1917. History of attempts to apply flotation to the silver ores. Results.

Status of Flotation—Patent Litigation (82793). R. C. Canby. 9500 w. Eng & Min Jl—Dec. 1, 1917. Lucid review of flotation-patent litigation in America.

The Effect of Addition Agents in Flotation (83003 A). M. H. Thornberry and H. T. Mann. 2200 w. Met & Chem Eng—Dec. 15, 1917. Serial, 1st part. Experimental studies. This article deals with the effects of sulphuric acid and a number of sulphates.

Precipitation

Charcoal Precipitation of Gold-Bearing Cyanide Solutions (83248 N). H. G. Walton. Ills. 1200 w. Chem Eng & Min Rec—Nov., 1917. Results in Australia.

Smelting

American Smelting v. Bunker Hill (82768). Abstract of affidavit by E. L. Newhouse, with editorial. 6500 w. Min & Sci Pr—Dec. 1, 1917. Serial, 1st part. Reviews causes leading to injunction suit, and development of modern methods of smelting, etc.

The New Smelting Works of the Mount Cuthbert Company (83247 N). Ills. 1200 w. Chem Eng & Min Rev—Nov., 1917. Detailed description of reduction works in Queensland.

PRECIOUS METALLURGY

Bunker Hill

American Smelting v. Bunker Hill (82954). Affidavit by F. W. Bradley. 5500 w. Min & Sci Pr—Dec. 8, 1917. History of the efforts of Bunker Hill to market its products.

Dredge

Yuba No. 16 Double-Stacker Dredge (82790). Lewis H. Eddy. Ills. 1000 w. Eng & Min Jl—Dec. 1, .1917. Details of one of the largest gold-placer dredges in the world, and the first double-stacker of its type.

Platinum

Recovery of Platinum in Gold-Dredging (82953). James W. Neill. Ills. 2500 w. Min & Sci Pr—Dec. 8, 1917. Methods of recovery; causes of loss; improvements in concentration.

Rand

Some Aspects of Rand Mining (83,-282). 2000 w. Eng & Min Jl—Dec. 29, 1917. Extract from Lord Harris' speech concerning difficulties under which gold-mining is now being conducted.

Redredging

Redredging—Will It Pay? (83483). Walter H. Gardner. Ills. 1500 w. Eng & Min Jl—Jan. 5, 1918. Discusses attempts to redredge areas in California.

Silver

The Halogen Salts of Silver at Wonder, Nevada (83048 B). J. A. Burgess. 1500 w. Ec-Geol—Oct.-Nov., 1917. Geology occurrence, etc.

MISCELLANY

Mine Report

Seventh Annual Report by the Director of the Bureau of Mines to the Secretary of the Interior for the Fiscal Year Ended June 30, 1917 (82929). Van H. Manning. 104 pp. U S Bur Mines—Dec., 1917.

Gold, Silver, Copper, Lead and Zinc in California and Oregon in 1916 (83,-156 N). Charles G. Yale. 55 pp. U S Geol Surv, I:8—Dec. 3, 1917. Statistics of production by counties.

U. S. Bureau of Mines

Activities of the U. S. Bureau of Mines for Year Ended June 30, 1917 (83191). 2500 w. Eng & Min Jl—Dec. 22, 1917. Summary of the year's work in relation to the mining industry.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION

Discipline

The Brown System of Discipline (82741). Sidney J. Keeler. 2500 w. Ry Age Gaz—Nov. 30, 1917. Studies by an employee of fifteen years' experience on both large and small roads.

Government Control

President Wilson Takes Over Railroads (83245). 1400 w. Ry Age Gaz—Dec. 28, 1917. Assuming government control of railways in the United States.

Government Operation

Government Operation of Railways Imminent (83024). With editorial. 7000 w. Ry Age Gaz—Dec. 14, 1917. Discusses the proposed plan, its advantages and disadvantages.

The British Railways Under Government Control (83147). F. A. McKenzie. 4500 w. Ry Age Gaz—Dec. 21, 1917. Problems Great Britain has solved.

Pooling

Pooling Railroad Equipment and Facilities (83026). Samuel G. Thomson. 3500 w. Ry Age Gaz—Dec. 14, 1917. Physical problems of pooling equipment and the needlessness of government control.

Eastern Railroads to Be Pooled (82,736). Also editorial. 2500 w. Ry Age Gaz—Nov. 30, 1917. Measures to relieve congestion.

Railway Problem

Evolution of the Railway Problem (82904). 1800 w. Ry Rev—Dec. 8, 1917. Serial, 1st part. Editorial discussion of the present railway conditions.

Russia

The Railway Situation in Russia (82,739). 2500 w. Ry Age Gaz—Nov. 30, 1917. Interview with Henry Miller. Describes conditions and gives recommendations.

Signaling

Use of Electric Fouling Bars in England (82940). T. S. Lascelles. Ills. 1500 w. Ry Sig Engr—Dec., 1917. Device applied in cases where the conditions would render track circuits of doubtful value.

Proceedings of the Annual Meeting of the Railway Signal Association, Sept. 18 and 19, 1917 (83166 C). 165 pp. Ry Sig Assn, Jl—Dec., 1917. Reports, discussions, etc., at Atlantic City, N. J.

Automatic Signals and the Automatic Stop (82845 A). From a paper by L. E. Jones read before the Pacific Ry Club. 3500 w. Ry & Loc Eng—Dec., 1917. Essentials of the automatic signal; systems, etc.

Light Signals on the Southern Pacific (82939). J. P. Robinson. Ills. 2500 w. Ry Sig Engr—Dec., 1917. Stock material utilized for a 7-mile installation.

Terminals

Decreasing Engine Terminal Delay (83044 A). 5000 w. Three prize papers. Ry Mech Engr—Dec., 1917. The need of organization and supervision.

War Railways

War and the Railways (83268). Leslie F. Van Hagan. Lectures. 16 pp. Wis Engr—Dec., 1917. Handling of troops and supplies at the front; and the handling of freight traffic.

MOTIVE POWER AND EQUIPMENT

Air Brakes

Train Lengths and Volume of Air Required for Brake Operation (82847 A). Walter V. Turner. 1000 w. Ry & Loc Eng—Dec., 1917. Gives formula for calculations of train stops and control of trains on grades, and action of brake equipments.

Cars

High Capacity Narrow-Gauge Rolling Stock for Burma (83078 A). Ills. 700 w. Engr—Nov. 30, 1917. Dimensions and description.

Narrow Gage Steel Hopper Car (83,043 A). Frederick C. Coleman. Ills. 700 w. Ry Mech Engr—Dec., 1917. For carrying mine products in Burma.

Refrigerator Cars for the B. & O. (83042 A). Ills. 1200 w. Ry Mech Engr—Dec., 1917. Details of interesting features.

Refrigerator Cars for the Baltimore and Ohio (82740). Ills. 1500 w. Ry Age Gaz—Nov. 30, 1917. Features of interest.

The Tank Car (83265). E. S. Way. Read before Car Foremen's Assn. of Chicago. 2500 w. Ry Rev—Dec. 29, 1917. Discusses rules of the construction and handling of cars carrying explosives.

Wood and Steel Car Construction (82765). H. S. Sackett. 4000 w. Ry Rev—Dec. 1, 1917. Urges increased use of timber in both freight and passenger car construction.

Clasp Brake

The Theory of the Clasp Brake (82,848 A). 1500 w. Ry & Loc Eng—Dec., 1917. What it is and what it does; its economics and advantages.

Counterbalance

Locomotive Counterbalance (82767). H. W. Snyder. 2000 w. Ry Rev—Dec. 1. 1917. Principles involved in the counterbalancing of two cylinder locomotives.

Electrification

Features in the Electrification of the Chicago, Milwaukee and St. Paul Railway, U. S. A., Including a 440 Mile Journey Through the Rocky Mountains (83215 N). J. W. Kirkland. 1500 w. So Af Inst Elec Engrs, Trans Sept., 1917. Remarks in connection with the showing of views.

Savona-Ceva (Italy) Mountain Railway Electrification (83277). W. Lesniewski. Ills. 1800 w. Elec Ry Jl—Dec. 29, 1917. Difficulties overcome by three-phase locomotives, including use of pushers. The line averages one tunnel per mile.

La Trazione Elettrica Sulla Linea Del Gottardo (83302 B). 2400 w. Monitore Tecnico—Oct. 30, 1917. Traffic and locomotive performance on the St Gotthard line.

Fuel

Successful Introduction of Pulverized Fuel on the Central Railway of Brazil (82844 A). Ills. 2000 w. Ry & Loc Eng—Dec., 1917. Account of the successful use of slack coal and its importance in Brazil.

Inspection

Federal Locomotive Inspection (83,041 A). Ills. 1500 w. Ry Mech Engr—Dec., 1917. Abstract of Sixth Annual Report of the chief inspector of locomotive boilers to the I. C. C.

Federal Locomotive Inspector's Report (83025). Ills. 1500 w. Ry Age Gaz—Dec. 14, 1917. Increase in supervision and inspection necessary.

Locomotives

Large Type of Locomotives for the Wabash Railway (82846 A). Ills. 900 w. Ry & Loc Eng—Dec., 1917. Increase in weight and tractive power.

Locomotives of the 2-10-2 Type for the Wabash (82868). Ills. 1000 w. Ry Age Gaz—Dec. 7, 1917. Large boilers make possible high sustained capacity.

New York Central 4-8-2 Type Locomotives (83244). Ills. 1500 w. Ry Age Gaz—Dec. 28, 1917. Type for freight service on low-grade line.

Santa Fé Type Locomotives for the Wabash Railway (82766). Ills. 600 w. Ry Rev—Dec. 1. 1917. Modern design of freight locomotive for heavy road service.

The "Ruston" Oil Locomotive (83,069 A). 1200 w. Engng—Nov. 30, 1917. Describes this industrial locomotive and its design.

Packings

Development and Manufacture of Journal Box Packings (82843 A). Ills. 1600 w. Ry & Loc Eng—Dec., 1917. Machines and methods used.

Supplies

Ordering, Distribution and Use of Supplies (83010 N). George C. Yeomans, with discussion. 32 pp. N E Rd Cb—Nov. 13, 1917. Principles necessary to secure best results.

Tenders

An Innovation in Tender Design (83,041 A). Ills. 800 w. Ry Mech Engr—Dec., 1917. Construction used on Rock Island lines.

PERMANENT WAY AND BUILDINGS

Freight Station

New Federal Street Freight Station of the Pennsylvania Railroad at Philadelphia (83005). Ills. 1500 w. Ry Rev—Dec. 15, 1917. Detailed description.

Rails

The Shortage of 10,000,000 Tons of Rails (83210 A). C. W. Gennet, Jr. 1000 w. Iron Age—Dec. 27, 1917. Statistics indicating too little rail renewal.

Relocation

Illinois Central Raises Line Above Flood Level (82725). Ills. 1500 w. Eng News-Rec—Nov. 29, 1917. Elevation of line near Vicksburg, Miss.

Snow Sheds

Concrete Snow Sheds on the Union Pacific (83243). Ills. 4000 w Ry Age Gaz—Dec. 28, 1917. A new form of protection from drifting snow.

Snow Shed Construction in the Cascades (83027). Ills. 2500 w. Ry Age Gaz—Dec. 14, 1917. New protection on the Great Northern. Types of sheds, design, location, etc.

Tests

Screw-Spike and Tie-Plate Test, Pennsylvania Railroad System (83275 N). W C. Cushing. Ills 253 pp. Am Ry Eng Assn, Bul—Oct., 1917. Laboratory and track service tests.

Track

Track Work for United States Army in France (82737). Ills. 1500 w. Ry Age Gaz—Nov. 30, 1917. Designs of frogs, switches and crossings prepared to meet special conditions.

ROADS AND PROJECTS

Africa

Railways in South-West African Protectorate (83200 A). 4500 w. Ry Engr—Dec., 1917. Abstract from annual report on S. African railways and harbors.

New Line

The Mansfield Railway (82838 A). Ills. 1500 w. Engr—Nov. 9, 1917. Details of a line in England constructed mainly to serve large collieries.

TRAFFIC

Commerce Commission

The Commerce Commission's Annual Report (82867). With editorial. 6500 w. Ry Age Gaz—Dec. 7, 1917. Review of its activities during the year about to close.

Congestion

Congestion Causes Alarming Conditions (82735 A). 2000 w. Iron Age—Nov. 29, 1917. Desperate conditions in eastern United States, and plan recommended for relief.

France

French Railroads Must Have Higher Freight Rates (82872). 3500 w. Ry Age Gaz—Dec. 7, 1917. Serious deficits. Fifteen per cent advances proposed.

Freight Handling

Handling Freight Faster with Fewer Men (82871). F. C. Myers. 3000 w. Ry Age Gaz—Dec. 7, 1917. Advantages of electric trucks.

Material Handling

Rushing Material for the Mechanical Department (83180). 1500 w. Ry Rev—Dec. 22, 1917. Duties of the rush clerk.

Reconsignment

The Reconsignment Privilege (82,738). H. W. Johnson. 1500 w. Ry Age Gaz—Nov. 30, 1917. Abuses to which the privilege has been subjected.

STREET AND ELECTRIC RAILWAYS

A. C. Railways

Inductive and Electrostatic Troubles Arising from A. C. Railways (82359 A). 2500 w. Elec Rev—Oct. 26, 1917. Interference with telephone and telegraph lines and methods of dealing with the difficulties.

Boston Subway

Progress on the Boston Subway (83,264). Ills. 1200 w. Ry Rev—Dec. 29, 1917. Data from the annual report of Edmund S. Davis. Features of work on the Dorchester tunnel extension.

Car Equipments

Layout and Installation of Motor Car Equipments (82806). H. R. Meyer. Ills. 1500 w. Elec Jl—Dec., 1917. Conditions to be considered.

Cars

New Cars for the Melbourne, Brunswick, and Coburg Tramways (82369 N). Struan Robertson. Ills. 1000 w. Comwh Engr—Oct. 1, 1917. Details of construction and important features.

Elevated

Manhattan Elevated Railway Improvements (83260 D). F. W. Gardiner and S. Johannesson. Ills. 193 pp. A S C E, Pro—Dec., 1917. Details of design of the steel structure, foundation work, method of erection, reconstruction of stations, etc. Always without interruption of traffic.

Express

Trolley Express Service in a Busy Industrial Community (82228). Ills. 2000 w. Elec Ry Jl—Nov. 3, 1917. Reports the profitable service of the Connecticut Co.

France

Construction Des Tramways Electriques Du Saint-Gironnais (82658 C + D). T. Bibès. Ills. 8900 w. Annales Des Ponts Et Chaussées—July-Aug., 1917. Electric railways aggregating 24.5 miles in length at and near St. Girons. Power plant, equipment, etc.

Overhead System

Catenary Overhead Construction (82,873). W. C. Lancaster. Ills. 5000 w. Elec Ry Jl—Dec. 8, 1917. Study of the design of the overhead system of the Montreal tunnel and terminal of the Canadian Northern railroad.

Railway Problems

Present Day Problems of the Railways (82159 A). L. S. Storrs. 3500 w. A E R A—Oct., 1917. Increased cost of labor and materials demanding increased revenue.

Depreciation and Rate-Making (82,770). 4000 w. Elec Ry Jl—Dec. 1, 1917. New England Street Ry Club discusses phases of these topics.

Signals

New 60-Cycle Signal Installation on the T. H., I. & E. (82477). Adolph Schlesinger. Ills. 3000 w. Elec Ry Jl—Nov. 17, 1917. Details of system on high-speed interurban line in Indiana.

Snow Fighting

Some Pointers on Snow-Fighting Equipment and Its Use (82608). P. Ney Wilson. Ills. 2000 w. Elec Ry Jl—Nov. 24, 1917. Lessons taught by recent experiences of the Connecticut company.

Speed

Constant Speed vs. Varying Speed Characteristics for Electric Railway Vehicles (82181). R. E. Hellmund. 3500 w. Elec Jl—Nov., 1917. Shows that in many cases constant speed is superior.

Springs

Reworking Electric Railway Truck Springs (82566). J. V. Hunter. Ills. 5000 w. Am Mach—Nov. 22, 1917. Methods used in the Middle West.

State Aid

State Aid for Physical Improvements (82874). 3000 w. Elec Ry Jl—Dec. 8, 1917. Suggests rehabilitation through state credit as a means of improving financial results of electric railways.

Stations

Design of Subway and Elevated Stations (83157 B). S. J. Vickers. Ills. 18 pp. Min Engrs' Jl—Nov., 1917. Matters that should receive consideration.

Substations

A Model Substation for a Chicago Residence District (82606). Ills. 3000 w. Elec Ry Jl—Nov. 24, 1917. Features of design in the new Commonwealth Edison substation.

The Operation of Railway Substations Without Attendants (82263 A). W. D. Bearce. Ills. 2000 w. Gen Elec Rev—Nov., 1917. Review of progress during the past three years.

Subways

Construction Problems of the Manhattan-Bronx, and Lexington Avenue Subway Junction and Queensborough Tunnel Connections (82941 D). George Perrine. Ills. 40 pp. A S C E, Pro—Nov., 1917. Connections in the vicinity of 42d St., New York, and extension of Queensborough tunnel.

Terminals

Union Freight Terminal at Kansas City for Interurban Lines (82607). Ills. 1500 w. Elec Ry Jl—Nov. 24, 1917. Four roads will use recently opened station.

Third-Rail

Voltage Rises in Third-Rail Circuits (83033). D. D. Ewing. Ills. 1500 w. Elec Ry Jl—Dec. 15, 1917. Study of the cause.

Three-Wire

Line Drop and Rail Potentials Reduced by Three-Wire System (82333). E. H. Hagensick. Ills. 1200 w. Elec Ry Jl—Nov. 10, 1917. Conditions improved in Omaha, Neb., by installation of 3-wire principle.

War Tax

How the War Tax is Collected (83,184). 1500 w. Elec Ry Jl—Dec. 22, 1917. Schemes for checking the collection of the tax paid on cash fares.

INDUSTRIAL MANAGEMENT
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War Protection for Industrial Plants

Duties of Owners and Employers in Protecting American Factories Against Sabotage and Disloyal Propaganda

By Hon. Thomas W. Gregory
Attorney General of the United States

American manufacturers have a more serious responsibility today for the protection of their plants than ever before. The chief dangers are those developing from within, not those coming from without. To aid the nation and our fighting forces industrial damage must be prevented; imposing a penalty on the guilty after a plant has been destroyed does not further our prosecution of the war.

Hon. Thomas Watt Gregory *was educated at the South-Western Presbyterian University, Clarksville, Tennessee, and admitted to the Texas bar in 1885. The legal firm of which he was the principal member was employed by the State of Texas as special counsel in various suits for violating anti-trust laws during the period 1908 to 1913; during 1913 he was special assistant to the Attorney General of the United States in charge of the investigation and prosecution of officials of the New York, New Haven and Hartford Railroad Company. Since August 29, 1914, he has been Attorney General of the United States in the Cabinet of President Wilson. His department has the responsibility for prosecuting cases involving sabotage and disloyality.*

THE people of the United States have pledged themselves to see this war through to the last dollar and to the last man. Before us lies an untold sacrifice of blood and treasure, much sorrow and heart-rending disaster, but the road is plain and leads to but one result.

This high pledge of everything that we have imposes upon manufacturers a more serious responsibility for the conserving and protection of their plants than has ever before been known. In reality, the war has made every manufacturer a partner of the soldier and sailor. Prior to the war damage to a plant or producing equipment was a private matter. If loss occurred the owner looked to the insurance companies for a large measure of recompense. Now that we are at war damage to plants has ceased to be a private matter. It is one in which the people as a whole are deeply interested. So far as the public interests are concerned, and so far as the welfare of our military forces are involved, no amount of money paid to a manufacturer can repair the loss of destroyed means of production. At the present time, perhaps as never before, *time* is the essence for success in our struggle for the preservation of our country and its national life. Every improvement in manufacturing processes, every advance in the means for reaching a military decision, every hour gained in speeding up production, shortens the war and saves American lives. In sharp contrast every loss and curtailment in production by damage done to manufacturing plants means lost time—delay—for which no amount of money can ever make up; and delay means inadequate military equipment, and inadequate military equipment for our army and navy means the loss of precious human life.

The Purpose to Injure the United States

We know the temper and unbridled brutality of our enemy. While we were neutral, struggling to keep free from the conflict, diplomatic and consular representatives of the German government in this country endeavored to wreck factories and railroads, attempted to debauch our officials and people, planned to embroil us in war with our neighbors and even tried to foment rebellion among our own citizens.

The purpose from which those acts came is still seeking internal injury to the United States

However, it is unwise to attribute every large fire in industrial plants, or among stores of manufactured materials, or along our waterfronts to the act of enemy agents, although it is very natural to suspect their activities. A recent case is the large fire at Newark, New Jersey, which was alleged to have been caused by our enemies, although an investigation by the government established the fact that it had other origin. But industrial loss through carelessness is as serious in its delaying effects as if the damage were caused by German spies.

Much less has been said and written of the danger from disloyal propaganda than concerning sabotage. It is sufficient to say here that the former is a most serious menace, much more so than manufacturers appreciate, and that the Department of Justice has been taking active and effective steps in its suppression.

MANUFACTURERS MUST PROTECT THEMSELVES

Statistics show that the chief dangers menacing private manufacturing plants are those which orginate or are developed within their own boundaries. The real protection needed is protection within the plant itself. And the prime responsibility for the internal protection of workshops and factories rests, as it always has rested before, upon the owners and managers.

The executives who are operating a plant have the best opportunity of knowing what persons are entitled to access to their premises, and of identifying those who are to be admitted. They likewise have the best opportunity of knowing the need of fire protection as well as for sufficient watchmen. Primarily it is their duty and not that of the central government at Washington to see that their plants increase the fire protection facilities, to feel out the sentiments of their employees, to take all possible precautions to prevent the spread of disloyal propaganda and to prevent possible injury to buildings and equipment. It should be their aim, as it is the aim of the government, to prevent damage rather than wait until damage is done and then impose penalties for losses that cannot be repaired.

The Department of Justice frequently receives requests from plants asking that military guards be furnished by the government. The War Department receives a much larger number of similar requests from manufacturers who apparently take the position that inasmuch as they are producing war material they are entitled to have their plants protected by an armed guard furnished by the United States. In most cases this is an entirely wrong point of view. The establishment of a military guard will not protect the plant against carelessness or malicious damage from within which have caused most of the loss in industrial plants since the beginning of the war. For example, the existence of a military guard in some cases has created a false sense of security instead of intensifying watchfulness in the plants. There are many spots, particularly at the seaports, where the collection of a large mass of war material practically constitutes the establishment of an army base. For the protection of these large stores of supplies the government has created protected areas which, by direction of the President, are receiving military protection in the form of an armed patrol furnished by the War Department, or supplied by the State authorities acting in coöperation with the War Department. In view of the particular character of the industry, certain shipbuilding plants are likewise receiving military protection. But that military protection should not be asked of the government outside of the lines laid out above.

MUNITION MANUFACTURERS HAVE RESPONSIBILITIES OF GOVERNMENT AGENTS

No government has, or can have, either the manpower, the physical means or the administrative machinery in a war of the present magnitude for supplying the precautionary methods needed in and about the innumerable plants manufacturing war materials and supplies. Owners or managers engaged in the manufacture, storage or transportation of war material should recognize the fact that they have had imposed upon them what amounts to the responsibility of government agents. They should frankly realize this and assume the attitude of providing in their plants extraordinary precautions. They have the right to ask ample police protection from local authorities, but that alone will not safeguard the interests involved. They have the right to call upon the government for all possible aid in ferreting out the sources of danger, but they have no right to ask the government to assume the responsibility for the work of internal police administration within their premises.

It is gratifying to be able to state that it has been the constant experience of the Department of Justice, and other departments of the government, that the great majority of plant owners have been quick to recognize the situation and act accordingly. But, on the other hand, there are many manufacturers who fail to take this view of the situation, vital though it is.

Violation of Industrial Rules

By Chesla C. Sherlock

Attorney at Law

COMPENSATION is denied under the workmen's Compensation Act if the injury is the result of the "serious and wilful misconduct" of the employee. The question of whether a violation of rules laid down by the employer amounts to such serious and wilful misconduct as to defeat recovery of compensation, is of great interest to employers.

The mere fact that an employee has disobeyed an express order of his employer is not sufficient to prevent him receiving compensation for any injury which he might have suffered. To permit this construction on the statute would be to return to the old days of chaos prior to the enactment of the compensation acts.

Inasmuch as the majority of the compensation acts do not expressly treat of this subject, it is evident that if the employee is not to receive compensation it must be denied him on the ground that his violation of the rules amounted to serious and wilful misconduct. Employers can readily appreciate the task that is before the courts in each case because of this necessity. Because of the situation mentioned, it is necessary for each case to stand on the circumstances peculiar to itself.

THE ENGLISH ATTITUDE

The English courts in speaking of the English act, which is the parent of our laws on the subject, said in so many words that a violation of rules is not serious and wilful misconduct. Our own California court has said that a violation of each and every rule which the employer has formulated for the protection of his employees is not, in itself, serious and wilful misconduct.

It is not, however, possible for us to stop here. It is very probable and, indeed, extremely likely that in a majority of cases where the employee violates rules he is guilty of serious misconduct.

Such a violation of rules must have been wilful. This, of course, implies that the employee had knowledge of the existence of such rule; that he deliberately and with premeditation set himself in opposition to the authority of his superiors. The courts have hastened to say, however, that where a workman wilfully violates his employer's rules, but with the intention at the time of furthering the employer's interests, such a violation will not amount to a serious and wilful misconduct so as to defeat a recovery of compensation.

The courts have drawn a sharp distinction, from the employer's standpoint, in regard to the violation of rules, which should be kept in mind. They have said that where the employer strictly enforces all rules and does so at all times, that a disobedience of them by an employee will, other considerations being equal, amount to wilful misconduct. On the other hand, they have also said that where the employer is lax in enforcing his rules, or does so only in a dilatory or nominal manner, a violation of them will not amount to wilful misconduct on the part of the employee.

A California Case

In a California case it was said that a definition of "wilful misconduct" applicable to all cases cannot be formulated. "It may be stated in a general way that the wilful violation of a rule or order made for the employee's own safety, or the safety of others, and made by a power having authority to make such rule or order, and enforced with diligence will constitute wilful misconduct. There must be a rule or order, as distinguished from a warning. It must have been diligently enforced. It must appear that the employee is refractory, or intentionally or premeditatedly disobedient, in order to constitute wilfulness."

It is unquestionably the opinion of the courts that if an employee violates a rule made for his own safety or protection from serious bodily harm, he is guilty of misconduct; if the violation is deliberate and premeditated, then the violation amounts to wilful misconduct. It would not be consistent with the purposes of the compensation acts to allow a workman, who was acquainted with all the dangers surrounding a violation of a rule formulated for his own protection, to recover compensation for injuries received because of his own disobedient act. This would be too close to an allowance of compensation for self-inflicted injuries, which is expressly forbidden by the compensation acts themselves.

Violation of Safety Rules

It is a general rule that a violation of safety rules laid down for the protection of employees engaged in hazardous occupations, is wilful misconduct. If there is no rule, an act by an employee which imperils his own safety is not wilful misconduct, unless it amounts to foolhardiness or dare-deviltry.

A failure of an electric lineman to wear a safety belt and rubber gloves, when such are required by his employer's rules, is a serious and wilful misconduct such as to defeat recovery for injuries received because of such violation.

The question of disobedience of orders involves slightly different construction on the part of the courts. While they seem to be reasonably clear in their interpretation of a violation of a fixed, known and positive rule, they are not so well settled in their opinions as to the effect of a disobedience of a direct command or order

Some courts have, apparently without any reason, other than a desire to see a widow compensated, awarded compensation where a workman had violated an order, which, if given in the form of a rule, would have prevented him or his dependents receiving any compensation at all.

A Massachusetts Case

In a Massachusetts case, a workman was employed to do some painting near machinery in motion. He was given express orders not to attempt painting behind such machinery until at the noon hour when it would be stopped. The workman commenced to paint behind the machinery, however, within five minutes after receiving such order, was caught in the machine and killed. The Arbitration Committee awarded compensation. It is very clear that if such instructions had been given in the form of a rule, that this employee would have gone without compensation, as his disobedience was beyond doubt deliberate and wilful.

Lord Trayner, in speaking of a disobedience of orders, has more nearly expressed the universal opinion, when he said: "I cannot figure anything more serious or wilful than positive and intentional disobedience to a strict and positive order."

Where the employer has been lax and permitted a violation of rules or orders in the past, it is not wilful misconduct for an employee to violate them in the present instance. The courts impose no uncertain obligation on employers in this respect. Where one employs labor in hazardous occupations, he is duty bound to offer a workman instructions as to his own protection and to formulate rules for the workman's guidance. If the employer has not done this, or has not enforced those rules given, then he cannot defend on the ground of the employee's misconduct.

Obligation to Post Rules

The further obligation is placed on employers to properly post such rules or see that they are brought to the attention of the workmen. Said the Lord President in an English case: "I think it goes without saying that a rule not properly posted is really no rule at all; it is merely a piece of paper in the employer's pocket, so to speak, and no question of breach can arise until the rule is posted."

In the final analysis, this question of the violation of rules is purely one of fact. To say that the mere violation of a rule, in itself, was sufficient to deny compensation would controvert the whole theory of the law. Said Lord Loreburn: "In my opinion it is not the province of the court to lay down that a breach of a rule is *prima facie* evidence of serious and wilful misconduct. That is a question purely of fact, to be determined by the arbitrator as such."

Engineers in Goverment Service

ENGINEERING Council, through its American Engineering Service Committee, has during the past few months supplied to various Government departments and bureaus in response to their requests, several thousand names of engineers from which were to be selected to fill a great variety of positions in uniformed and civilian service for Army and Navy and other branches of the Government's activities in connection with the war, as well as for indirect service for manufacturers and contractors engaged upon Government war work.

To meet these demands the American Engineering Service Committee has assembled in its offices in the Engineering Societies Building, New York, extensive lists and much detailed information concerning engineers in all branches of the profession throughout the length and breadth of land.

Engineers reading these lines, to whom this request applies, are urged to send at once their names, present addresses and occupations in the Government service, with brief statement as to whether or not they are available for other service, to American Engineering Service Committee, Room 901, 29 West 39th Street, New York Other readers are asked to bring this request to the attention of such engineers or to send information directly to the committee.

Operation Diagrams for the Executive

How the Manufacturer of War Material Can Visualize Processes

By Adalbert R. DeKuzelewski

Shop executives who do not handle the tools of production, but who are responsible for keeping everything moving, often need to refer to the general plans of production operations, manufacturing machines, tools and gages. This article gives a method of concentrating all this information on compact operation diagrams. The example illustrated is a cylinder of a Russian automobile engine.

Mr. Adalbert R. DeKuzelewski *was born in Poland and received his professional education as a mechanical engineer in the Polytechnicum in Zurich, Switzerland. Coming to the United States a few years later, he has since held the positions of tool room foreman and tool designer with the De La Vergne Machine Company, tool designer with the Northway Motors & Manufacturing Company, and master mechanic with the R. K. LeBlond Machine Tool Company. For the last two years he has been chief engineer in the New York office of the Russo-Baltic Car Works Company, a Russian machinery building firm.*

While the busy executive as a rule is not supposed to look into the details of manufacturing, and the main problem confronting him is the selection of competent assistants to take care of this end of the business in an efficient way, nevertheless, in order to see whether every department is being run properly, it is necessary for him every once in a while to have the means to analyze the most minute details of the shop without wasting too much of his valuable time. Besides, the important task of keeping the different departments well balanced in regard to each other—that is, to avoid shop conditions due to which, for instance, the screw-machine department would work double shift while there would be a number of milling machines standing idle—can only be done successfully by the man in full charge. To do this requires ways and means of having a picture, a description of shop details ready within reach of his hand, to get hold of the necessary data immediately and be able to give orders which can be carried out and bring results.

To achieve this end, the executive, whether he is the president, the works manager, the shop superintendent or the chief engineer, must have the data in such shape that every detail can be understood at a glance and located in a few seconds without going into an elaborate system of filing cabinets, card indexes, loose leaf binders or the like. Having all this in view, we have devised a special system of machine-shop operation diagrams which will be explained below. This system has been carried out with excellent results at the offices and shops of the Russo-Baltic Car Works Company, a large Russian concern manufacturing military automobiles and 16-passenger aeroplanes, having an office in New York City where the purchasing of machines and designing of special equipment is being done.

The Cylinder Drawings

After all necessary operations to be performed on a given part—for example let us take the standard cylinder for the automobile engine—were determined upon, all the jigs, fixtures and appliances and small tools designed, laid out and made in the shops, every single operation was drawn up separately on a sheet about 12 x 18 inches in size supplied with necessary margins to allow for loose leaf perforation. These drawings have no dimensions, but show explicitly the way the cylinder is placed in the fixture or the jig, the way of locating and clamping, the way the fixture is fastened on the machine, and show a picture of the entire manufacturing problem and all the appliances used.

Six sheets (four reproduced herewith) take all twenty-three operations (see Table I) necessary to get the cylinder machined ready for assembling, except such simple processes as sand blasting or cleaning, where no special equipment is required. They show, in a clear way, the idea of each jig, the kind and number of tools which go with it in a way to be understood by anyone who has a general idea of machine-shop work, but without being a trained expert in shop methods.

Now to go on with the story: Each operation diagram drawing was made on a sheet of standard size transparent paper. The piece being machined was drawn up with red ink, while the jig, fixture or tool was drawn with black pencil. This work completed, a blueprint was made of each, and all the blueprints perforated and bound together into a large book for the superintendent,

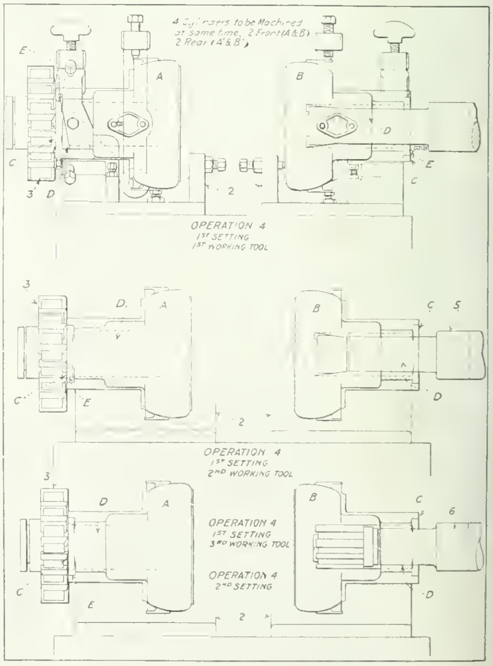

4 Cylinders to be Machined at same time, 2 Front (A & B) 2 Rear (A' & B')
A
B
C
D
E
2
3
5
6
OPERATION 4 1ST SETTING 1ST WORKING TOOL
OPERATION 4 1ST SETTING 2ND WORKING TOOL
OPERATION 4 1ST SETTING 3RD WORKING TOOL
OPERATION 4 2ND SETTING

FIG. 1.—SET-UPS FOR OPERATION 4 ON AUTOMOBILE CYLINDER

Operation 4. 1st setting, 1st working tool:

Face C of cylinders A and A'.
Rough bore D of cylinders B and B'.
Chamfer E of cylinders B and B'.

OPERATION 4. 1st setting, 2nd working tool:

Face C of cylinders A and A′.
Finish bore D of cylinders B and B′.

OPERATION 4. 1st setting, 3rd working tool:

Face C and cylinder A and A′.
Ream D of cylinder B and B′.

OPERATION 4. 2nd setting, revolve 180 degrees and face C of cylinder B and B′:

Rough bore D of cylinder A and A′.
Chamber E of cylinder A and A′.
Finish bore D of cylinder A and A′.
Ream D of cylinder A and A′.

master mechanic and tool designer,—let us generalize—for our factory office.

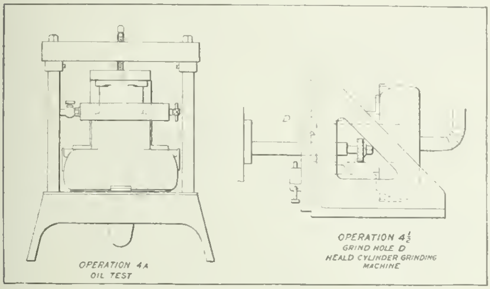


FIG. 2.—SET-UPS FOR OPERATIONS 4A AND 4½ ON AUTOMOBILE CYLINDER

Next a reduced size photoprint of each drawing was made also, a photoprint just the size of a letterhead. By this time every operation sheet was already typewritten on the same size of white sheet. To each operation sheet was attached the corresponding diagram and all bound into a ring binder 8 x 11 inches in size and placed on the desk of the busy executive.

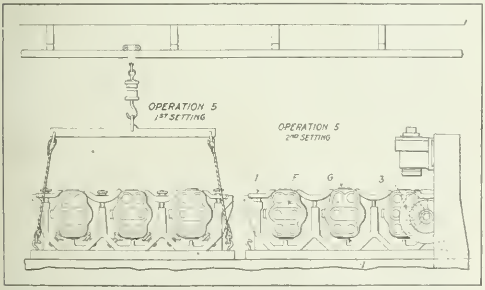


FIG. 3.—SET-UP FOR OPERATION 5 ON AUTOMOBILE CYLINDER

OPERATION 5. 1st setting:

Rough and finish Mill F.
Rough Mill G
Rough Mill H.

OPERATION 5. 2nd setting:

Rough Mill I.
Rough Mill J.

TABLE I. SCHEDULE OF OPERATIONS, MACHINES, TOOLS AND GAGES FOR AUTOMOBILE CYLINDER

1. Clean casting; sand blast.

2. Snag casting; machine, floor grinder.
Hourly production per machine, 30.

3. Inspect for blow holes and defects in casting; bench.

4. Bore, chamfer and ream two cylinder bores and face mill base of casting; 1st bore 103.5, 2nd bore 104.0, 3rd ream 104.7 mm. (0.3 mm. allowed for grinding). Note. If cylinders are not ground, hole must be reamed to 105.00 — 0.0125 mm., 2nd bore to 104.5; machine, Beaman & Smith Locomobile milling and boring machine; tools, four special fixtures, boring bars, adjustable reamers, face milling cutters; gages, Plug, 103.5 — 103.65, plug; 104.5 — 104.60, plug; 105.0 + 0.0125.
Hourly production per machine, 6.

4A. Grind cylinders (if desired); machine, Heald cylinder grinding machine; tools, special fixture; gages, as above.
Hourly production per machine, 1.

5. Mill top (right and left) manifold pads and valve pocket cover surfaces (single cut); machine, Beaman & Smith continuous milling machine; tools, four special fixtures each holding three castings, special cutters; gages, valve pocket depth gage for width on fixture.
Hourly production per machine, 20.

6. Mill fan bracket pad; machine, No. 2½ LeBlond milling machine; tools, plate fixture, face mill; gages, on fixture.
Hourly production per machine, 20.

7. Mill water pipe pad; machine, No. 2½ LeBlond milling machine; tools, plate fixture, face mill; gages, on fixture.
Hourly production per machine, 20.

8. Drill six bolt holes in bottom of cylinder flange; machine, Natco No. 30; tools, trunnion jig to take operations 8, 9, 10, 11.
Hourly production per machine, 20.

9. Drill manifold and pump pad and valve cover pad on one side of cylinder; machine, No. 14, Natco multiple spindle drilling machine; tools, same jig.
Hourly production per machine, 20.

10. Drill manifold and valve cover pad on other side of cylinder; machine, four-foot Carlton radial drill; tools, same jig, Magic chucks.
Hourly production per machine, 15.

11. Drill fan bracket pad in front of cylinder; machine, four-foot Carlton radial drill; tools, same jig, Magic chucks.
Hourly production per machine, 20.

12. Machine four valve holes (except thread), leave stock on seat for hand reaming after valve stem bushing is in place; machine, 17D Moline 6-spindle drilling machine; tools, special jig (on rails), special counterbores, special valve tools, special boring bars, grinding gages; gages, special gages for depth, plugs for size. (Tools should be made in duplicate.)
Hourly production per machine, 6.

13. Drill, tap and counterbore two cored holes in each end of cylinder; machine, Colburn drilling machine; tools, drill jig, special counterbores 80 mm. in diameter, tap, counterbore; gages, depth gage, thread gages.
Hourly production per machine, 10.

14. Tap valve plug holes; machine, Colburn drilling machine; tools, no jig, collapsing tap, chasers; gages, thread.
Hourly production per machine, 15.

15. Test under water pressure for leaks in jacket; tools, special fixture for testing at 60 pounds.
Hourly production per machine, 10.

16. Force in valve stem bushings; machine, arbor press.
Hourly production per machine, 30.

17. Ream valve stem holes (if necessary); bench; tools, special tool for reaming; gages, plug.
Hourly production per machine, 15.

18. Finish face valve seat; machine, Taylor & Fenn drilling machine; tools, piloted facing tool index fixture; gages, gage for angle and concentricity.
Hourly production per machine, 15.

19. Tap all small holes; machine, Taylor & Fenn sensitive radial drilling machine; tools, no fixture, taps; thread gages.
Hourly production per machine, 10.

20. Grind valves in place; machine, Foote-Burt valve grinder; tools; plate fixture, lapping compound; gage, prussian blue.
Hourly production per machine, 6.

21. Inspect valve seating; bench; gages, indicating prussian blue.
Hourly production per machine, 15.

22. Assemble valves, springs and collars; bench; tools, valve lifters.
Hourly production per machine, 20.

23. Final inspection; bench; all gages.

After manufacturing is started and first lot of parts are completed, the time each operation takes is entered on each picture. It will then take only a few pages at the end of the book, and a few hours time of one of the clerks, to tabulate how many hours of each type of machines it takes to get out a lot of 100 parts.

Advantages and Savings

Everybody will realize how much time the executive can save by having all this wealth of information in the shape of a compact book on his desk. But the busy executive is not alone at the factory—he has his assistants. The works manager will find the description of each operation of service just at the moment when he is selecting additional equipment; he may be able to make up his mind without calling in a master mechanic or foreman, without analyzing drawings in the tool-drafting department, without following up all operations on—let us say—the connecting rod which happens to be made in four different departments. The master mechanic who is just about inventing a new scheme and wants to know if it is really simpler and cheaper than the old one can refer to the book. The superintendent who has just received a report that the turret lathe department holds up production by being constantly overloaded, and who contemplates having some of the work thrown into the drill press department can see what to shift by looking into the book. The chief tool designer who wants to tell a man engaged last night to use the milling scheme he has used on last year's model universal joint cage tells him to get the book. And so on including the director of the night school for apprentices. (We will need tool designers and foremen ten years from now just as much as presently.)

Drawings Need Not Be Expensive

While the objection can be raised relative to the cost of these drafting diagrams, it may be added that the work in question for a draftsman who has been in a drafting room where this has been done would be an easy task. After he gets broken in, gets to understand the idea, leaves out the unnecessary and concentrates on the essential, the work proceeds rapidly.

These drawings do not have to be scaled. A good deal of assistance can be given by having standard elements like milling machine tables or lathe turrets once made to scale on cloth, and then retraced on each diagram—but these details can be left to the chief draftsman.

There is no question but that where big quantities of work go through the shops, like the case mentioned, the system described is of great practical value. So long as it shows the operations and in legible form the entire picture of the shop processes and methods, it will pay for itself within a few weeks in saving the time of the highest priced men. Its educational value for the future is an asset acquired entirely free of charge.

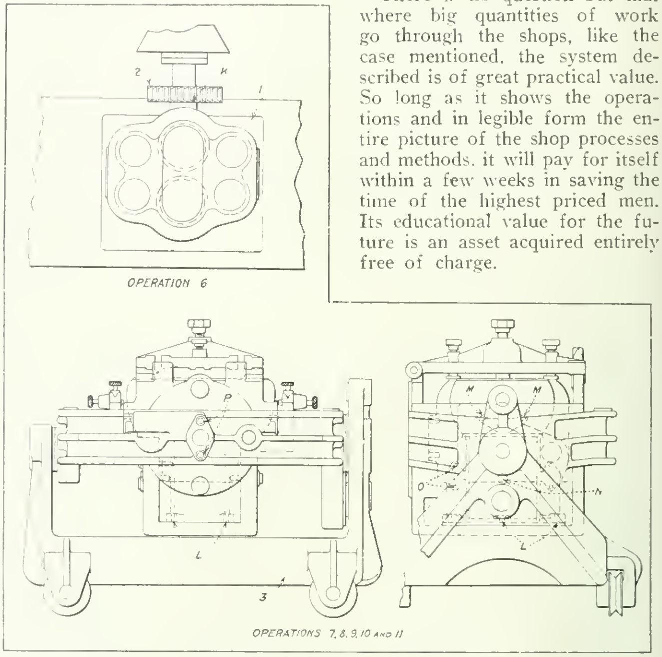


FIG. 4—SET-UPS FOR OPERATIONS 6, 7, 8, 9, 10, 11, ON AUTOMOBILE CYLINDER

Operation 6:
Mill K.

Operation 7:
Drill L, 6 holes.

Operation 8:
Drill M ⎫
Drill N ⎬ On one side of cylinder.
Drill O ⎭

Operation 9:
Drill M ⎫
Drill N ⎭ On second side of cylinder.

Operation 8:
Drill M ⎫
Drill N ⎬ On one side of cylinder.
Drill O ⎭

Operation 10:
Drill M ⎫
Drill N ⎭ On second side of cylinder.

Operation 11:
Drill P.

It may be added that in case of contracts for different parts of one machine, which are sometimes given out due to crowded shop conditions, a method of illustration as described above will certainly help everybody concerned.

Help Solve The Transportation Problem

In Connection With the Railroads

1. Coöperate and put it over. Do not kick at changes.
2. Load and unload promptly. Do not wait for a convenient season.
3. Load to capacity.
4. Do not reconsign en route. Decide the destination before the goods leave.
5. Pack securely and mark plainly.

For the Waterways

1. The construction of barges and small tow boats to provide for the adequate use of existing highways.
2. Provision for putting into shape existing waterways that have been allowed to become obsolete.
3. Provision for the wise extension of these waterways to correlate with the railroad system.

Chemistry and Industrial Management

By Ellwood Hendrick

To check wastes of materials in industry we must buy only what we can use, use it intelligently and reclaim all possible by-products from the scrap. The author points out that chemical reactions enter into all manufacturing to a greater or less degree, and makes a plea for chemical control including the purchase of all materials on specification and the check of everything received.

Mr. Ellwood Hendrick *received his professional education under Victor Meyer, and Merz and Weith at the University of Zurich, Switzerland. From 1881 to 1884 he was manager of the Albany Aniline and Chemical Works, and later was in chemical manufacturing for himself. At present he is a member of the staff of Arthur D. Little, Inc. He is a writer on chemical subjects and is the author of "Everyman's Chemistry."*

EVERY time a shovelfull of coal is thrown into the fire-box of a boiler, a whole series of chemical reactions take place. When metal is melted in a cupola all sorts of things happen; in fact there are very lively goings on within the domain of chemistry or of physics every time a piece of metal is heated. Painting is a chemical process, and a very complex one, too, and so is nearly everything that happens in a tank or a tub.

We can't get away from chemistry in industry; the most we can do is to shut our eyes to it and that is not always profitable. It has to do with the administration of materials. The eye of the master, according to Benjamin Franklin, is an invaluable asset, but its blind spots do not count. It may observe the men, see that they are diligent and well directed, and it may see that correct practices are observed, but unless it has the vision of chemistry, it cannot see how materials behave, and these are as important in making profits as are men.

Chemical Control in Manufacturing

Chemical control does not mean having a laboratory with a man, a balance, some reagent bottles, test-tubes, beakers, caseroles, Florence flasks and the like in it. One can't even select a good young chemist unless he has chemical understanding himself. The bane of American manufacturing has been that chemistry and physics have been neglected while the administration of materials has been placed in charge of foremen who do not know molecules. Those are the fellows who put things over on the old man. A young chemist, fresh from college, can't make any headway against them because they have entrenched themselves. And the young college man isn't up to the job of chasing molecules all around through the works and finding out what they are up to, anyway. That is the chemist's task: he is a molecule chaser. Nobody can see molecules, but they are always organizing, sometimes nice and obedient, just as the master desires; and then again they could give an anarchist organizer spades and trumps in sabotage. A young fellow at twenty dollars a week, who is under instructions to stay in his laboratory and make tests, can't determine how they are behaving. Conditions in little glass bulbs are very different from those in big iron containers. Laboratory processes that are rich in yield often show marvelous divergencies when a factory charge is made. Under different relations of mass to surface and with changed conditions of temperature and pressure, the molecules form new and entirely unexpected unions and it takes more than a little experience to catch onto their ways. The chemical engineer is to materials what the lawyer is to contracts and business procedure, and he needs experience as well as schooling.

Chemical Advice in Industry

The point that I am trying to make is the need of sound, competent, chemical advice in the operation of a manufacturing concern just as good legal advice is needed in its organization and whenever, for instance, the old man loses his temper.

The last word has not been said in regard to any known chemical reaction—so there's nobody who knows it all. On the other hand, there is hardly a single industry that lacks its chemical side. Even the matters of fuel, boiler water and lubrication are neglected unless they are under chemical control, and neglect means waste. A glance at laboratory records of analyses of boiler compounds which have been bought at prices mounting up to several thousand dollars a year for single plants is enough to make a manager sick. A late one was a little molasses in water at a dollar a gallon.

Chemical control enables a manufacturer to know his product. Usually he guarantees his output and his guaranty is a liability. The knowledge that this control gives him of his product insures him against loss under his guaranty. So if it discharges a liability it is an asset. It substantiates also the manufacturer's own trademark. On the other hand it discounts the trademark premium he pays on his raw materials. In normal times a man who buys on specification usually enjoys a buyer's market; if he buys trademarked goods it is usually a seller's market.

Unintelligent Buying

A street railway company has constantly before it problems of painting, cleaning, lubrication, the purchase of metals for various purposes, requiring different qualities that are bought either on specification or by trademark and a hundred other chemical problems; these must be met, or ignored. With no reflections upon the wisdom and judgment of purchasing agents, I think the statement cannot be successfully contradicted that the one who has access to a thoroughly equipped and manned laboratory will save a great deal more for his company than the one who has not. There are corporations that have their favorite sources for supplies of all kinds and if anyone tries to demonstrate that their methods of purchase may be improved upon, they successfully make a goat of him. The old man or somebody in authority sees to it that no change is made and that they continue to buy as heretofore from old friends. Then the old friends see to it that the company gets goods at fair prices. Thus the buyer leaves everything to the seller. This may make the seller and it may not break the buyer, but it is not intelligent buying.

The other day the writer went into a well-known clothing and furnishing house in New York City to buy an overcoat. The purchase was made—and, "Yes," he needed some underwear; medium light balbriggan. The price was $2 a garment, or $4 a suit. It seemed dear. The house is of the first rank and the proprietors urge upon customers that they can get best served by buying all their wearing apparel there. But those shirts and drawers seemed dear. Two suits were bought instead of the number desired on the ground that he might do better somewhere else. The next day he went over to Third Avenue, where he was probably taken for a prosperous walking delegate. "All our goods iss strickelly shoonion made," said the salesman. But underwear of the same weight, staple and finish were purchased for 75 cents a garment, or $1.50 per suit. The first lot was bought on trademark, the second lot on specification. The seller does not look out for competition and the buyer does—if he is alive to his job. With chemical advice the competitive field is open; without it it is closed; you must buy what your hired man says he can use.

Savings on Odds and Ends

A retail dry-goods merchant and a chemist were having an idle chat one evening when the merchant said, in a joking way, "You chemists are getting your teeth into everything, but you can't make anything out of my business. I am immune from the chemist's attack." "You need him," said the chemist, "in the worst way. You sell drygoods and guarantee them. From the time they were made until you get them they may have changed hands three or four times and what only a textile chemist could tell you about the merchandise you sell and warrant would be illuminating and I fear occasionally it would shock you. But let us leave that out of consideration. I shall approach you on the subject of testing drygoods for you a little later when my equipment is complete. What do you say to a nice little dinner party next year to be paid for by you or me according to the outcome of what I am about to propose? Suppose you tell me that you want my establishment to look into your supply department. That means besides fuel such odds and ends as paper, stationery, soap, etc. We shall charge you our regular fee and make specifications for purchases. If you do not make savings above the cost I will pay for the dinner, and if your savings are worth while, you are to pay for it."

The merchant agreed, and paid for the dinner because his savings were several thousand dollars. There was some $600 saved on soap powder alone for washing floors. Theretofore it had been bought as package or trademark goods.

Specification and Check

Merchandise, whether fuel, supplies, raw materials or finished products, is of three kinds: Standard, special and proprietary. For standard goods tests are established. Usually the chemist is needed to check. For special goods he is needed to specify. Proprietary goods are sold under patents or in packages with labels and directions or in connection with service which shows how to use them and get the best results. The item of service in connection with proprietary articles is growing rather than decreasing, as is evident from the increasing number of engineers and chemists employed in sales departments. It is wholly legitimate, but it is a charge that must be loaded upon sales. It is of advantage to the seller because it tends to close the market to the buyer. If on the other hand, the buyer knows exactly what he wants and how to use it, and knows also of several sources of supply instead of one, and can specify so that any one of the several producers can furnish the product he wants, his economical position is improved.

Here we are in the midst of the worst war in history, with billions and billions to be paid as the least cost of it and labor almost impossible to secure, and yet we see great wastes flowing out of the spigots on every hand. If we could only utilize intelligently everything we waste we could almost pay for the war as it progresses. Of course, applied science has not got as far as that yet, but it is much further advanced than the unscientific man knows. How manufacturers can afford to get along without having competent chemical advice constantly available to them is beyond the comprehension of most chemists.

Misconceptions About Chemists

There are a number of misconceptions about chemists abroad and we might as well consider one or two of them. When a manufacturer gets into trouble about his product he does not always come to headquarters by any means. He waits and waits and tries this and that and finally, when he comes to the conclusion that there is no balm in Gilead, he goes to the chemist with his woes. His overhead charges are a thousand dollars a day, his wares will not sell because something about them is wrong, and "What is the matter with the goods? Answer immediately," is his demand. Now the trouble lies in the way the molecules have been behaving and it may take months to find out.

If he had had the habit to take his troubles where troubles belong, to his chemical advisor, he would have had somebody working on the problem from the time the difficulty first showed itself, and by the time he sent his nervous telegram, the problem might have been solved. There's no use in trying to hurry such things: if one loses his pocketbook he does not set a date by which it must be found; he's thankful to get it at any time. The chemist's task in discovering what is wrong is often much harder than finding a lost pocketbook. Sometimes he gets it and sometimes he doesn't. In problems of research like this what he needs most is time. Tests go through a well managed laboratory in short order, but research will not be hurried.

Another idea that is unfortunately current is that a chemist can analyze anything. Now he can indeed analyze anything, but his analysis will not always tell what the thing analyzed is or how it is made. Chemistry isn't a finshed science by any manner of means. There is a vast amount that isn't known yet and the chemist has to feel his way along, just as the business man has to feel his way along in establishing credit. His problems with materials are almost as individual as the business man's problems with men. But the chemist is the only one who can actually discover what is happening to materials as they pass through the works on their way to become saleable goods.

The business man who takes his problems to the chemist will be surprised to find how wide their chemical side is. He is likely to be surprised at a great deal of information that will develop. But if he wants to be ahead of the game he must invite chemistry into his business and keep it there. The way to do that is to get a sense of the chemical aspect of his works before the day of trouble comes.

Definition of Engineering Council

Adopted February 21, 1918

Engineering Council is an organization of national technical societies of America created to provide for consideration of matters of common concern to engineers, as well as those of public welfare in which the profession is interested, in order that united action may be made possible. Engineering Council is now composed of the American Society of Civil Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers and American Institute of Electrical Engineers, having a membership of 33,000 and known as the Founder Societies.

Mastering Power Production III.

Materials Can Only Be Mastered By Knowing All the Facts

By Walter N. Polakov

Following the declaration of the principle that exact knowledge must be possessed before materials can be properly selected the author states, "In case of materials entering into a process of power production, the cost of the materials has little or no bearing on the cost of the finished product." The example used to illustrate these principles is coal. Under the headings of "Care of Materials" and "Care of Equipment" methods for planning and caring for all the materials and supplies of the power plant are fully outlined. Emphasis is laid on the importance of fitting both materials and equipment for the service to be performed.

Mr. Walter N. Polakov *is a consulting engineer specializing in the management of power plants. He was educated in Russia and Germany, held a position of shop superintendent and chief engineer in Russia and was also instructor and consulting engineer to the Naval Academy at Baku. After coming to this country, and prior to taking up his own practice, he was consulting engineer to the Board of Estimate and Apportionment of New York City, consulting engineer for the Penn Central Light & Power Company and Superintendent of Power of the New York, New Haven and Hartford Railroad Company.*

GREAT historical events reflect the state of mind of contemporary people. Moreover, it is the economic structure of society or the mode of production that, in the final count, determines the ideals. The world war which commenced as a clash between efficiently organized production on one side and antiquated financial control of markets on the other, gradually took the form of a crusade for liberation from imperialistic oppression or, stated in more definite terms, for the abolition of autocratic power and arbitrary use of special privileges.

To win a war, whether international or industrial, one must master materials better than his opponent. To accomplish this task, it is necessary to eliminate all guess, uncertainty, favoritism and waste; a definite predetermined, impartial and efficient use of materials is a *conditio sine qua non* of success.

So long, however, as our industries and public utilities are controlled by men whose vision is limited in a narrow circle of private gains, small wonder that the representatives of the people extend over them governmental control. The feeling of distrust spreads toward managerial methods based upon obsolete ideals and fostered by the conditions of the past, and the right to mismanage socially necessary production and transportation, or to waste the nation's natural resources, is being gradually taken away.

PRICES *versus* VALUE OF MATERIALS

The most conspicuous of this harmful inheritance from the age of mercantile capital is the habit of judging the value of services and of goods alike from their market price. Men, who are traders by profession and speculators by temperament, are accustomed to accumulate wealth by buying cheap goods and reselling them for what the traffic will stand. The process is thus to transform money into commodity and exchange it later for a larger sum of money. Buying certain materials needed in the process of power production is made with an intention to realize larger returns when the raw material reappears in the new form of a marketable commodity—energy. As a mere bookkeeping proposition, it looks as if the lowest price paid for these materials is capable of enhancing the profit, or the difference between the cost-price and the market-value of the power.

A technically unsophisticated purchasing agent, or an official dictating the policy of a concern, is often trapped in the tenets of this fallacy. While it might be true in a case of direct reselling of merchandise, that the low purchase price leaves a larger margin for profit, *in case of materials entering into a process of power production, the cost of the materials has little or no bearing on the cost of the finished product.* In fact, this rule is practically without exceptions, provided the purchase price is commensurate with the quality of the materials.

Inasmuch as nothing but scientifically conducted experiment under service conditions, carried out by a trained engineering investigator, can establish the fact of *what article is cheapest to use, as opposed to what is cheapest to buy*, the purchasing agent should be directed only by properly established standards. To enable their timely revision, he should report to the engineers setting the standards any fluctuations in the purchase prices of all cataloged materials. It is hardly necessary to illustrate this assertion by examples only too well known to the operating engineers, but often obscure to the financial directors. A cheap grade of lubricants, anti-friction metals, boiler tubes, fittings, etc., does not only enormously increase the maintenance expense but seriously jeopardizes the safety of men and property and, above all, frequently causes interruptions in service with all its disastrous consequences.

Of all the materials used in the steam power plant the fuel (more specifically coal), for the reason that it is by far the largest item in the operating expenses attracts more attention to the problem of its selection than even the operators themselves.

COAL AS AN EXAMPLE

The most primitive form of selecting coal is the comparison of prices per ton. This is occasionally modified by legal regulations, security of deliveries, terms of contract, and similar commercial considerations. Thus in New York City anthracite has been favored and even enforced so long as law-makers believed bituminous coal to be smoky; in Maine, Pocahontas and New River coal were in vogue, even in steel furnaces, since little ash may be hauled over the long route; in Pennsylvania, sometimes ill fitting coal is brought from far away mines because of a lower bid per ton on a long term contract.

In the first decade of this century the methods of buying bituminous coal on a heat value basis became fashionable. The more conspicuous of these methods were those of the United States Geological Survey, Interborough Rapid Transit, City of New York and The Celluloid Company. It was as much a step in the proper direction as the selection of food on its calorific value yet the parallel goes further. A dietician knows that foods of equal heat value have different coefficients of digestibility; moreover, there are proteins that stop animal growth while others stimulate it. Similarly, it is not half enough to know that a million B. t. u.'s cost so much and the price may be further adjusted according to the variation from the normal proximate analysis. The fitness of the coal for existing furnace, service, local conditions, etc., must be carefully investigated before it can be said whether the coal containing most B. t. u.'s for a penny is the cheapest to use or not.

The greatest unquestionable merit of this method of payment for coal lies in the fact that *it calls for exact knowledge.* The knowledge of the quality of delivery on the part of the buyer stimulates the seller to exercise care in preparation of the order; eventually the knowledge of the effect of the composition of coal on the ultimate results obtained helps the user to adjust specifications to the requirements, or *vice versa* to modify the conditions of use according to the character of fuel. Neither of these adjustments could be made without a knowledge of the characteristics of the coal. Moreover, the contents, the nature of the volatile matter, peculiarities of ash, etc., must be known *before* the coal is used, since variations in the properties of coal call for different ratios of air to coal, shorter or longer periods between levelling or cleaning fires, thicknesses of fuel bed, etc., if high efficiency is to be had.

The importance of the information obtained from the coal laboratory could hardly be emphasized enough, and a modest investment for its simple equipment is perhaps the best investment after the boiler room instruments, from the viewpoint of returns. The employment of an outside laboratory, however, is warranted only in a case when the analysis returns are available before the coal is delivered in the boiler room. The knowledge of what kind of coal has been burned is no consolation if the methods of its utilization were guessed wrong.

Social Meaning of Waste

Before outlining successful methods of mastering materials it is timely to point out what is meant here by "economy," "saving," and similar expressions. While it is common to measure any kind of unprofitable use of time, material and effort—i. e., waste—in terms of money, the true social meaning of waste (as opposed to saving) is both deeper and broader than merely loss of money. Any material has a value only insofar as it is the product of labor. Coal represents labor of an endless chain of men—lumbermen, teamsters, steel-mill workers, machinists, chemists, railroad men, farmers, architects, cattle men, engineers, doctors, miners and so on, probably without a single exception *all* trades contribute in their toil, even without knowing it, to the possibility of working out mines.

From this standpoint any waste of coal, or any other material, means that a certain amount of the work of all these numberless men, whose work intricately depends one upon the other, is rendered useless. This in turn means that the time they toiled to produce something that is thrown away was not used to anybody's good. As this waste is considerable the sum total of the portions of time that all the men worked to produce something that is wasted is very large. Sometime ago, in Austria a careful study revealed the fact that if all this waste be eliminated, as well as wasteful occupations abolished, the male population of between the ages of 16 and 50 could produce all that is regularly consumed working less than four hours per day.

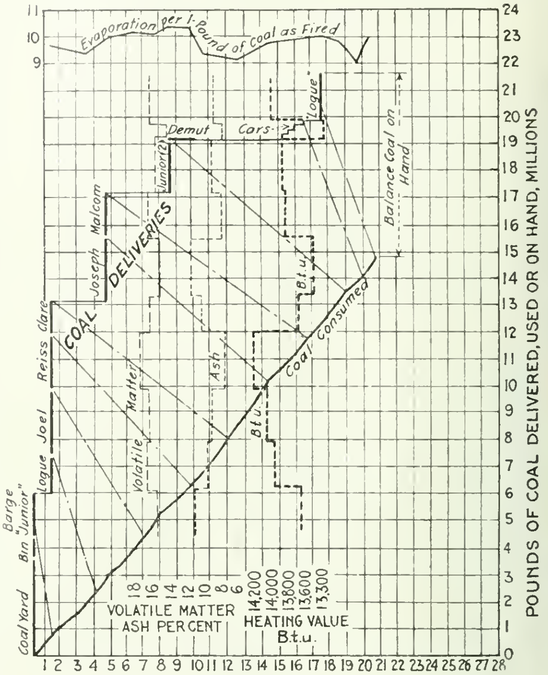


FIG. 4. COAL RECORD CHART

To drive the point nearer home, our wastefulness and mismanagement wore out the whole industrial mechanism to the extent of requiring five days of emergency repair and ten Mondays for patching, since an economic structure that is based solely on production for private gain develops internal contradictions leading to its ultimate collapse.

Managerial Functions

Those directing the production of power, or any other commodity, cannot ignore the responsibilities coupled with their authority. Waste in any form means the ruination of the individual enterprise as well as the undermining of the prosperity of a community.

It is quite obvious that most of the losses occur in operation due to the imperfect organization, lack of knowledge and resulting poor methods, but it is equally evident that no improvement along these lines can be made until we learn how to master the materials we use. This function is decidedly managerial, inasmuch as workman, firemen, engineers, etc., are expected to use the equipment, supplies and materials *provided for them,* and if they are unsuitable for attainment of predetermined results the entire responsibility rests with those causing such handicaps. The functions may be divided into two main groups, "Care of Material" and "Care of Equipment."

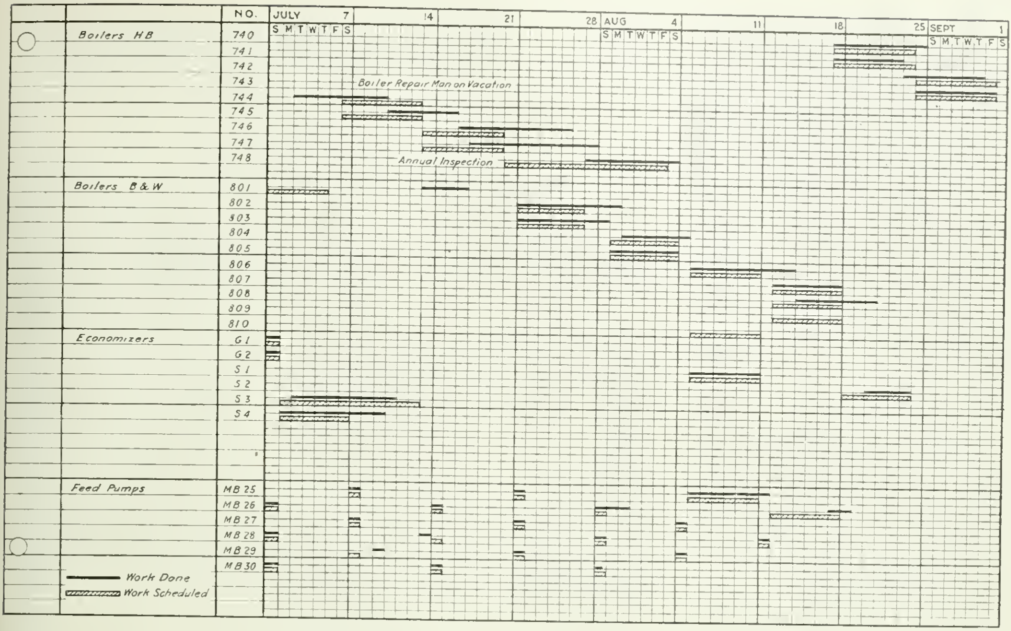


FIG. 5. MAINTENANCE RECORD OF LARGE POWER PLANT

The organization to care for materials embraces the following details:

Selecting materials.
Purchasing materials.
Testing materials.
Storing materials.

Similarly the care of equipment embraces:

Scheduling maintenance.
Specifying work.
Providing labor and material.
Instructions.
Compensation.

CARE OF MATERIALS

All materials used in connection with power production are controlled by the planning office from the time of issue of the purchase order until the articles are issued for use by the storekeeper.

To facilitate identification of stores for charges, etc., all stores are classified into five groups:

Raw material as the name indicates, is the material which is converted into product though losing its identity, such, for instance, as fuel.

Supplies are all standardized materials used in the plant, being neither converted into product nor forming parts of the equipment, such as lubricants, stationery, cleaning materials, tools and implements, etc.

Maintenance stores include all such articles as are used for maintaining the plant and equipment in perfect operating condition, as spare parts, gaskets, transformer oil, boiler compound, motor brushes, etc.

Second-hand stores. All returned parts of the equipment, etc., not needed temporarily are returned to the store and issued subsequently in preference to similar new articles. They constitute second-hand stores.

Scrap and refuse. All material that has lost its usefulness for the plant is turned over to the store to be sold or otherwise disposed of, for instance, old boiler tubes, brass parts, grates, ashes, burned out lamps, etc.

When the planning office establishes standard specification for material, the purchasing agent is notified and no other article should be substituted unless such course is unavoidable and the planning office is notified in advance so that necessary measures can be taken to minimize the ill effect of the use of that which is less suitable. Such material as needs constant testing is sampled and submitted to the laboratory for test and report prior to the use of the new delivery. Besides coal, such a procedure may be found necessary for fire brick, transformer oil, new unclassified purchases, etc.

The storekeeper is the custodian of all material in the plant. As every article represents money paid for it, the same care must be exercised over it as for cash in a safe or a bank. Receiving, storing and issuing is carefully recorded and the following seven rules rigidly observed:

1. Check every delivery as to quantity and standard of quality.
2. Have only the prescribed quantity of each article on hand.
3. Order new purchase only when amount left is equal to that designated as "order point," i. e., just enough to last until a new supply reaches the stores.
4. Issue from old stock until exhausted. Never mix new and old lots.
5. Issue only on presentation of store issue slip properly indorsed.
6. Orders, issues and permanent balance of stores shall be handled through the planning office.
7. Take care to protect stores against deterioration.

Small quantities of constantly needed stores may be kept in a sub-store and handled by the watch engineer as the storekeeper's representative in his absence.

As the most important item of material used in a power plant is coal, special problems are presented in its care. The quantity of coal to be stored is a complicated question depending on numerous local conditions which cannot be discussed here at length. Plant operation free from interruption is a chief factor; deterioration and possibility of spontaneous combustion should also be taken into account. Interest on the coal pile seldom receives due attention. All deliveries being unequal in quality and characteristic, it is undesirable to mix various coals, while again this seldom can be avoided. A chart, shown in Figure 4, is a very serviceable means of reference and control, as it shows at a glance the quantity on hand at any day, quality of each delivery or daily consumed mixture, movement of cars or barges, demurrage, daily receipts and consumption, result obtained and other useful information.

Necessity of Planning Handling of Material

The next function the management should take care concerning materials is their handling or moving. It is obvious that to execute any work requiring use of material we must know:

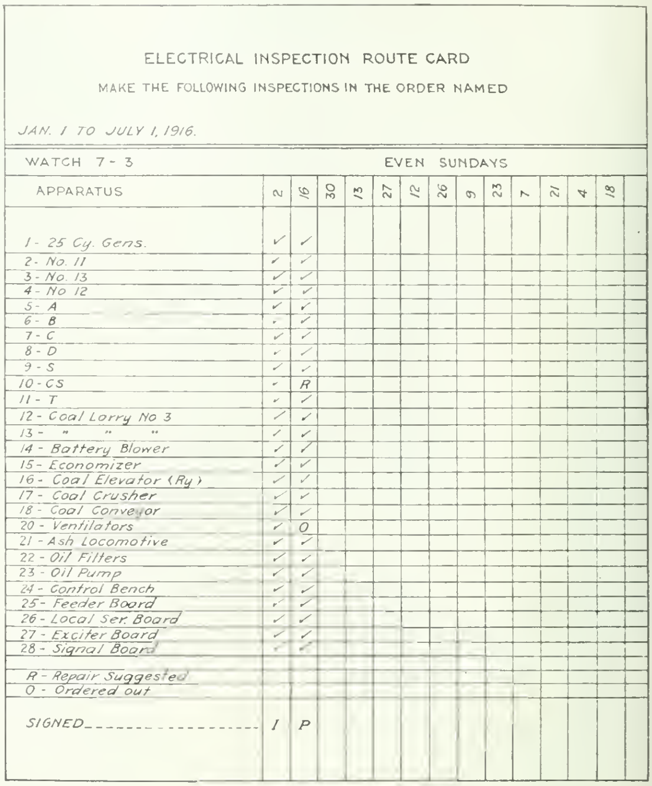
1. What material is needed.
2. Where it is needed.
3. When it is needed.
4. What is to be done with it.

Very often when certain work is to be done in a plant, merely a general order is given as to what is wanted. The man is left to find out for himself when the machine will be available to work on. When he starts he discovers that he needs certain materials; then he hunts for it and when he gets it he takes plenty to avoid shortage while working, and when he is through the left overs are stuck somewhere in a cupboard. The good excuse is "to have it handy next time," but as it regularly happens "next time" he can't find it. The story merely repeats: waste of time to find out what is needed, waste of more time to go and fetch it, waste of excess material. Yet no mechanic could be blamed for it as his job is merely to do the work, and not to manage the power plant.

We detail duties of such a nature to the planning office. The experience of the planning engineer aided with standards and records helps him avoid mistakes and save the time of the mechanic and the cost of the job. While the organization and functions of the planning office will be explained later on, suffice it to say in this connection that *the control of issuing, moving and using of materials is one of the duties of the planning office,* a most vital organ of a power plant.

Care of Equipment

The maintenance of equipment in first-class operating condition is another imperative task of a planning department. Proper upkeep of power equipment is of far greater influence on output and economy than it is in any other manufacturing department. Neglect to clean the heating surface of boilers, prevent numerous little leaks here and there, etc., seriously affects the cost of power. Careless, sporadic inspection of equipment is much more hazardous in power plants than anywhere else, as it may result not only in crippling one section of a plant, or even cause a shutdown, but is liable to cause more serious disaster. The old saying that a stitch in time saves nine is nowhere more



ELECTRICAL INSPECTION ROUTE CARD

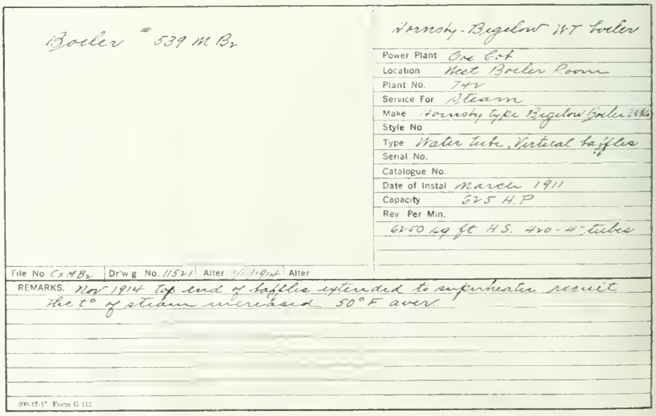
MAKE THE FOLLOWING INSPECTIONS IN THE ORDER NAMED

JAN. 1 TO JULY 1, 1916.

WATCH 7 - 3 EVEN SUNDAYS

APPARATUS	2	16	30	13	27	12	26	9	23	7	21	4	18	
1 - 25 Cy. Gens.	✓	✓												
2 - No. 11	✓	✓												
3 - No. 13	✓	✓												
4 - No 12	✓	✓												
5 - A	✓	✓												
6 - B	✓	✓												
7 - C	✓	✓												
8 - D	✓	✓												
9 - S	✓	✓												
10 - CS	✓	R												
11 - T	✓	✓												
12 - Coal Lorry No 3	✓	✓												
13 - " " "	✓	✓												
14 - Battery Blower	✓	✓												
15 - Economizer	✓	✓												
16 - Coal Elevator (Ry)	✓	✓												
17 - Coal Crusher	✓	✓												
18 - Coal Conveyor	✓	✓												
20 - Ventilators	✓	O												
21 - Ash Locomotive	✓	✓												
22 - Oil Filters	✓	✓												
23 - Oil Pump	✓	✓												
24 - Control Bench	✓	✓												
25 - Feeder Board	✓	✓												
26 - Local Ser. Board	✓	✓												
27 - Exciter Board	✓	✓												
28 - Signal Board	✓	✓												
R - Repair Suggested														
O - Ordered out														
SIGNED__________________	I	P												

FIG. 6. INSPECTION ROUTE CARD



Boiler #539 M Br

Hornsby-Bigelow W.T boiler

Power Plant Cos Cob

Location West Boiler Room

Plant No. 742

Service For Steam

Make Hornsby type Bigelow Boiler Wks

Style No

Type Water tube, Vertical baffles

Serial No.

Catalogue No.

Date of Instal March 1911

Capacity 525 H.P

Rev Per Min.

6250 sq ft H.S. 420-4" tubes

File No Cx M Br | Dr'w g No. 11521 | Alter 1/1/1914 | Alter

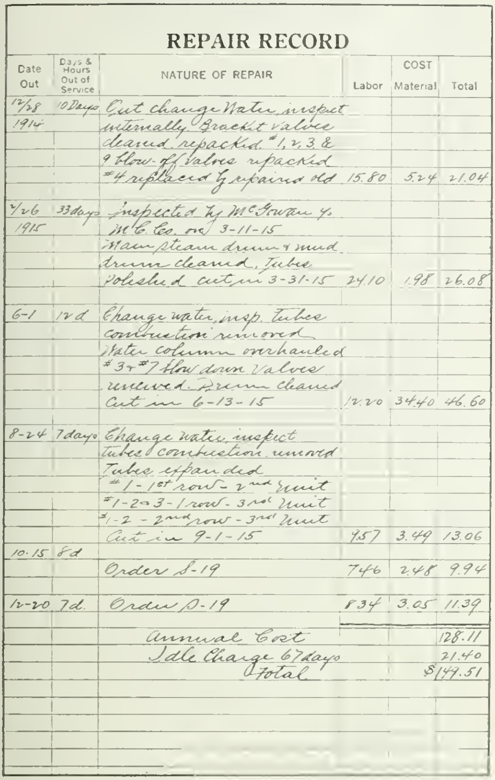
REMARKS. Nov 1914 top end of baffles extended to superheater result the t° of steam increased 50°F aver.

200-12-1" Form G 112

FIG. 7. FRONT OF EQUIPMENT RECORD CARD

applicable than it is in the modern power plant.

To secure the possibility of obtaining uniformly good results from proper methods of operation—that is, make it possible for the men to live up to their tasks and earn a bonus—the plant's equipment must be maintained in uniformly good condition. To that end, the planning department contributes by studying physical causes affecting economy and safety and determines reasonable periods at which inspections, cleanings and other similar work shall be made. Such schedules are exemplified by the chart of Figure 5 and the electrical inspection card of Figure 6.



REPAIR RECORD

Date Out	Days & Hours Out of Service	NATURE OF REPAIR	COST Labor	Material	Total
12/28	10 Days	Out change Water inspect			
1914		internally. Bracket valves			
		cleaned repacked #1, 2, 3 &			
		9 blow-off valves repacked			
		#4 replaced by repairs old	15.80	5.24	21.04
2/26	33 days	inspected by McGowan &			
1915		M.C. Co. on 3-11-15			
		Main steam drum & mud			
		drum cleaned, Tubes			
		Polished cut in 3-31-15	24.10	1.98	26.08
6-1	12 d	Change water, insp. Tubes			
		combustion removed			
		Water column overhauled			
		#3 & #7 blow down Valves			
		renewed. Drum cleaned			
		Cut in 6-13-15	12.20	34.40	46.60
8-24	7 days	Change water, inspect			
		tubes combustion removed			
		Tubes expanded			
		#1-1st row-2nd Unit			
		#1-2 & 3-1 row-3rd Unit			
		#1-2-2nd row-3rd Unit			
		Cut in 9-1-15	957	3.49	13.06
10-15	8 d				
		Order S-19	746	2.48	9.94
12-20	7 d.	Order S-19	834	3.05	11.39
		Annual Cost			128.11
		Idle Charge 67 days			21.40
		Total			$149.51

FIG. 8. BACK OF EQUIPMENT RECORD CARD

The by-effects of work done at regular intervals are: Reduced time the equipment is idle, reduced number of maintenance men needed, lower repair and maintenance cost, and above all, the operating men (who may be poor mechanics) are not dividing their attention between operating functions and mechanical work, but consistently live up to their tasks.

The general procedure of this work is simple. The planning department assigns at specified intervals the qualified men to make inspection routes through the plant and report all findings on a card. Necessary repairs are authorized by the issue of a work order specifying details and time when it is to be started and finished so as not to interfere with operating requirements. When the job is finished, all expenses are computed and entered on the record card, Figures 7 and 8, one covering each unit of equipment in the plant. The data on these cards are further used in the planning department to analyze what method of repair and what material produces the best results at the lowest cost, and thus leads to continual improvements.

As far as stimulation of maintenance men is concerned, they receive their bonus over and above the daily wages only for those days when no interruption in operation occurs on account of their defective maintenance, and they lose their bonus whenever it is proved that the operating men fall short of their tasks on account of poor upkeep. For instance, a firemen fails to secure the expected boiler-efficiency rating, because the gage connection is leaking and he adjusts the damper in accordance with wrong indications. This would be the instrument man's fault, not the fireman's, and while the former will lose his bonus, the latter may be allowed his, if nothing else was wrong. To carry out this plan, it is evidently the duty of the planning department to investigate every failure at once, before the man affected comes back for his next turn; otherwise, the mistake may be unknowingly repeated and a late investigation may not reveal the real cause.

The success of our maintenance method depends in no small degree upon careful selection, standardization and purchase of all supplies and materials. The maintenance record cards, Figures 7 and 8 referred to before, are of material assistance for at least abandoning the use of supplies and materials that prove short-lived and expensive. Expensiveness, however, is figured out in the planning department not as cost per pound, foot, or what not, but as cost per time. Such data often give an effective weapon to fight some short-sighted purchasing agent's hobby to buy the cheapest stuff on the market, or a general fancy that the most expensive is the best. Neither of these generalities can, of course, remain true in all cases. In this way, for instance, it may be found that a very cheap and comparatively poor quality of firebrick gave excellent results if used in conjunction with a somewhat expensive fireclay cement, or that expensive grease for cylinder lubrication was cheaper to use than the cheapest cylinder oil, etc.

To sum up, when a plant is operated on the principle of task-work-with-bonus, this method of caring for equipment becomes still more important, as *the task may be accomplished only when the equipment is in first class operating condition.* Falling short of the predetermined economic result by an operating man because of poor maintenance is not a reason to deny him his bonus; in fact its payment serves as a penalty on the management for failure to keep the plant in the best possible shape, or unwisely saving on material.

How far such neglect to take proper care of equipment sometimes goes may be well illustrated by a case of a New Jersey power house. Several years ago, the maintenance of the plant was averaging $4,000 per month. In the past years this account was reduced by almost half, with the result that not only the coal consumption per kwh. was increased in a dangerous proportion, but the capacity of dirty, neglected equipment was reduced so materially that any overhauling would necessitate curtailment of the output.

Emphasis is laid in this article on the importance of careful fitting of materials and equipment for the service: far greater importance must be attached to the men whose work consists in keeping the plant in a condition that permits the utilization of its ultimate efficiency. A successful mastering of the material side of a power plant calls for more than first-class mechanics engaged in its up-keep—it presupposes a clear comprehension by the management of its first function: *To base orders on facts.*

(To be continued)

Handling Bulk Material by Man and Machine Power—A Comparison

By George Frederick Zimmer

This article is based on British practice and gives comparative costs of handling coal by hand labor and by machinery. By hand labor the per ton labor cost may range from one-fifth to one-half of an hour's wage; by machinery the author gives a handling cost per ton as low as 0.94 cent.

Mr. George Frederick Zimmer *was associated for fifteen years following 1882 with Mr. James Harrison Carter, the well known pioneer engineer of English roller milling. In 1897 he started practice as a consulting engineer, and at the same time began to market a reciprocating steam conveyor of his own development. He is an extensive writer on the art of mechanical handling of materials and is the author of two books, "The Mechanical Handling of Material," published in 1905, and "The Mechanical Handling and Storing of Material During and After the War," published in 1917.*

A MODERN plant for the mechanical handling of material, unless of very small capacity, cannot help being a commercial success, for we need only bear in mind that an expenditure of from £750 to £1,000 ($3,652 to $4,870) on machinery is justifiable, if one labor unit can thereby be dispensed with. Yet the careful investor would like fuller information in order to enable him to calculate beforehand approximately what he will save by his capital outlay. Reliable information which will give us the comparative cost of handling say a ton of coal is, however, difficult to obtain, as it depends to a great extent on specific conditions, but the following brief data will help us to form approximate estimates for a variety of propositions.

So far as hand labor is concerned we find:

1. An average man, paid at piecework rate, can shovel coal out of a railway truck at the rate of five tons per hour, either into a hopper forming the receiving terminal of a coal handling device, or into any other receptacle, provided its upper edge does not reach in height beyond the floor level of the railway truck. The actual cost of handling one ton of coal in this way would be one-fifth of the hourly wage, plus a small allowance for wear and tear on tools

2. If the coal is to be unloaded and wheeled in a barrow a distance of 100 feet, and then stacked by means of a gang plank in a heap of an average height of six feet, one man can handle 3.4 tons per hour. A coal heap of an average height of six feet must be understood as the average between 0 and 12.

3. In order to reclaim the coal from a heap by shovel and barrow, and wheel it to a point 50 to 100 yards away —say, 75 yards as an average—and empty the coal there, one man can handle two tons per hour, so that the cost of one ton thus handled will be equal to half-an-hour's wage; for every 10 yards additional distance conveyed, one-fortieth of the hourly payment must be added to this.

It is rather difficult to make reliable statements concerning general comparisons between the hand labor for discharging railway trucks, and that performed by mechanical means, particularly as these latter appliances are generally fixtures, and are therefore best adapted to serve a mechanical handling plant; a coal truck to be discharged by hand can generally be shunted into a position nearest the spot where the coal is to be used or stacked.

There are also a great variety of tips driven by either hydraulic or electric means; some raise the trucks to an angle of 45 to 50 degrees, at which they completely empty; others turn them over laterally, such as the M'Myler Tip, by an angle of 135 degrees, which will give the side of the truck, when turned over an angle of 45 degrees. Others again will turn the truck through an angle of 180 degrees, also sideways, so that it is exactly upside down. It is therefore advisable to obtain an estimate from the makers after deciding upon the type of tip and the number of trucks to be discharged per hour.

We will take, for example, an electrically driven tip for end-door trucks, which raises the truck floor to an angle of 45 to 50 degrees.

Such a tip would cost, approximately	£625	$3,043.75
Foundations	150	730.50
Connections with all necessary wirings	125	608.75
Turntable	250	1,217.50
Together	£1,150	$5,600.50

The capacity of such an installation, if for five trucks per hour, will be, annually, about 160,000 tons maximum. To work the tip one driver and one laborer are necessary. As an additional safeguard against breakdowns and for the sake of greater economy it would be better to employ two tips, and use each only for a capacity of 80,000 tons. If two tips are thus employed the turntable will not be necessary, as if they are erected right and left the end door trucks can be emptied if the door is foremost or at the rear. With such an arrangement these tips need only be at work for about 3½ hours per day, and the cost of handling, per ton, will be about three farthings (1½ cents). For current we need not reckon more than 0.03 kw. hour.

The accompanying table shows the economy effected by the use of such tips, for different quantities per annum, according to B. Ludwig's observations on such plant.

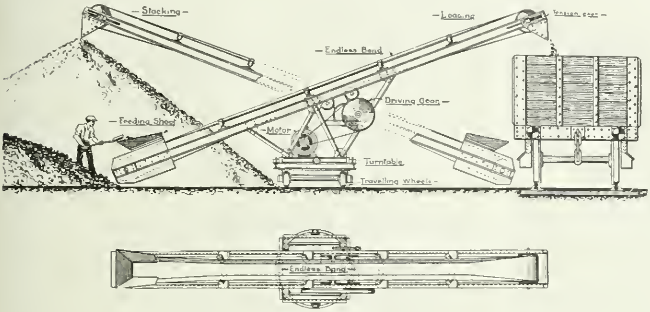
COST OF HANDLING COAL IN AN ELECTRICALLY OPERATED TIP

Tons per Annum	Cost per Ton		Capital Cost Only	
	Pence	*Cents*	*Pence*	*Cents*
8,000, Including Capital, Current and Labor	3.37	7	3.06	6
16,000	1.9	4	1.54	3
24,000	1.43	3	1.17	2
32,000	1.19	2	0.94	2
40,000	1.05	2	0.8	1
48,000	0.96	2	0.7	1
56,000	0.90	2	0.63	1
64,000	0.88	2	0.58	1
72,000	0.80	2	0.55	1
80,000	0.77	2	0.51	1
88,000	0.75	2	0.49	1
96,000	0.73	1	0.47	1

NOTE.—Pence have been converted to cents on the basis of one penny equal to two cents.

Under pre-war conditions the cost of hand labor for unloading railway trucks worked out at about 2½d (5 cents) per ton, so a tip of the above description would be economical for handling annually 13,000 tons and upward.

When (as in problem 2, page 190) the material, after unloading, has to be conveyed to any distance the machine proves even more economical than the man in problem 1. and this becomes increasingly evident the longer the distance and the greater the tonnage per hour. For very small installations hand labor may be cheaper, or in cases where the material has to be raised as well as conveyed. Even if there should be cases in which it can be proved that hand labor is cheaper than the machine it certainly is not so quick as the work of a conveyor, and the rapid disposal of all bulk goods at terminal points saves demurrage charges of vessels and freight cars, and on that account alone the machine would be more economical than manual labor if it could be employed at an equal rate of cost. But generally speaking mechanical appliances are more economical than hand labor, even for small installations.



Concerning problem 2, the machine which conforms best to the flexibility of hand labor is a portable device, such as the Mitchell Loader, which is essentially a telescopic band conveyor mounted with its motor on a carriage running on standard rail tracks. The conveyor can be slowed in all directions, being mounted on a turntable, and can be luffed so as to take cargo from the cars to the heap, or vice versa. Machines of this kind are made in sizes of 16, 20, 24 and 30 inches wide, from 20 to 40 feet long, and of capacities from 30 to 100 tons per hour. It is manufactured by Messrs. Fraser & Chalmers, Ltd.,

A similar machine is shown in the illustration on this page; it is however not telescopic but for fixed lengths, and is mounted on travelling road wheels and not upon rails.

In cases where the material has to be lifted to a higher level mechanical appliances are far more economical than hand labor, even in the case of very small capacities, and particularly so when the lift is higher than a man can throw with a shovel, for hand labor is then practically out of the question, for the coal would have to be shovelled into baskets, carried on men's shoulders up a ladder or gang plank and emptied, an operation which can still often be seen when ship's bunkers are being coaled One man can, in this way, only handle about one ton per hour. In connection with this performance we must remember that it is in reality the actual power capacity of the human handling machine if unaided by mechanical appliances. The basket is no machine, while the wheelbarrow must be looked upon as a primitive labor aiding machine.

If we take one ton per hour as the handling capacity of a man, we find that such simple appliances as a rope, pulley-block, and winch will increase his capacity to two tons per hour, for with nine men filling the baskets in the lighter and emptying them into the bunkers, and three men working at the winches—12 men in all 24 tons per hour can be handled. With a mechanically equipped collier having a complement of seven men in charge, coal can be transferred at the rate of 700 to 800 tons per hour, or say 100 tons per man.

With the recently erected loading scheme at Durban, one man in charge of a M'Myler Tip can handle 1,000 tons per hour, and so can the man in sole control of the loading machinery. These achievements are too obvious to require a comment and we need not haggle as to their economy. But there is one more aspect. The man in charge of such a handling machine constitutes, so to speak, the brains of the machine, his physical man power does not come into consideration, as would that of the coal-heaver who handles but one ton, and therefore girls are now frequently employed for such purposes. Now there is no reason why disabled soldiers should not be employed on such work. The writer believes that such employment would be most suitable for intelligent but physically disabled men, who could from their comfortable seat in the cabin manipulate the levers, brakes, and controls of such a conveying plant.

When handling abrasive material such as coke, and especially incandescent coke, most handling machines will require repairing and renewing to such an extent that a point must be reached when hand labor is more economical than machine labor, and this will be more noticeable in the case of continuous conveyors, where the gritty dust of the coke disintegrates and the heat distorts the moving parts. On the other hand, with such intermittent handling (where one or more tons of coke are handled in a large receptacle) the upkeep is infinitely less, as such receptacles are not so susceptible to damage, having no intricate parts, and moreover the cost of repair is much smaller in the latter case, and such repairs can generally be done by a handy man on the job.

Flexibility of the Telpher

The telpher, which is now so often used, may to some extent be compared with manual work on account of possessing the greatest possible flexibility, but when its path has once been decided upon it is fixed by its rail track, and the man in charge of the telpher performs a task analogous to the one with the barrow, only instead of having to push the barrow, the barrow—so to speak—pushes him, and instead of his barrow holding only a hundredweight or two, it will hold a ton or more. In addition to this, one man can, with his telpher machine travel at the rate of 500 feet per minute, whereas a man wheeling a barrow can only travel about 50 feet per minute. Telphers are particularly recommended where the distance is too great for continuous conveyors.

A complex handling installation is generally too expensive in first cost for undertakings of relatively small capacity, while such plant for large capacities costs but comparatively little more. Thus, for instance, an installation capable of handling 50 tons per hour, with which the writer is acquainted, cost £20.000 ($97.400), while an almost identical plant for double the capacity, i. e. 100 tons per hour, will cost only £21,000 ($102,270).

Mechanical handling devices will only become economical when certain quantities have to be handled, and with every type of machine there is a point below which hand labor must be cheaper, and the more economic a machine the lower the capacity for which it becomes economcial.

A few actual examples may be of interest. As these examples do not rest on the same basis they cannot be tabulated or otherwise presented in a more striking and attractive form, but they are certainly both very obvious proofs of the economy of machine handling.

Take the coal handling plant of the City Road Station of the London Electric Light Company. Here the coal arrives in barges and was formerly elevated to the boiler house floor at a cost of one shilling (24 cents) per ton, by manual labor. Now it is delivered into the bunkers at an inclusive cost of 5d. (10 cents) per ton, which also includes the water supply for driving the hydraulic crane which unloads the coal.

Another example is a coal handling plant for unloading barges by a cantilevered bucket elevator which delivers on to a drag-link or U-link conveyor, which is at work at the Corporation Electricity Works, Coventry, and was erected by Messrs. Ed. Bennis & Co., Ltd., Bolton. Before the installation of this plant manual labor was employed and the coal was raised in baskets by men out of the barge, conveyed a distance of about 50 feet on a gang plank and thrown into the store. The new installation can handle the coal with a saving of 60 per cent. over the former cost.

Expenditure Chart for Executives

By F. J. Schlink

Associate Physicist, Bureau of Standards

THE type of chart shown herewith is a mode of graphical accounting. While based on simple and well-understood principles, it has not, so far as is known, been applied in the work of the business administrator. Its use relates particularly to the needs of the administrative officers and executives, whose knowledge of financial conditions should be such as to give them control of tendencies and policies in expenditures. For this purpose, it is not necessary to know the exact balance on a given fund to the nearest cent; what is needed is a form of statement which will give very approximately the amounts of the individual expenditures, show them in their relative magnitudes, and indicate at a glance whether or not the amounts available will suffice to carry the project through the fiscal year with a satisfactory margin for contingencies; whether the proportion of administrative salaries to expenditures directly applied to production is a reasonable one, and whether the work to be done has been planned in advance as well as the data in hand will permit. No argument is needed to show the advantage of graphic methods in business management; that manner of delineation is well established nowadays and occupies an important place in modern and well ordered industrial plants and offices everywhere.

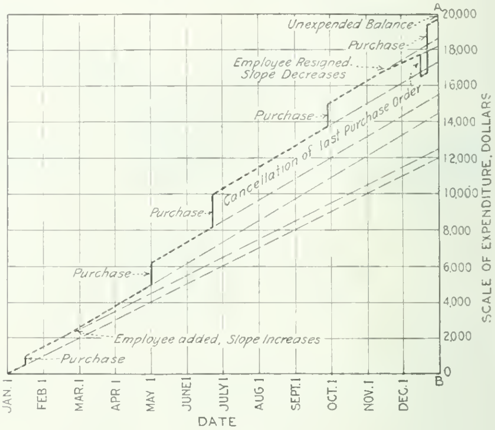
The chart, as shown, is made up of broken lines. Inclined lines represent continuing expenditures, such as salaries, insurance and rent, while vertical lines represent direct and definite outlays, such as those for furniture, machines, supplies, printing and the like. Vertical distances represent expenditures, horizontal distances, time.

For the sake of example, assume a plant having an experimental or development department for the maintenance of which the sum of $20,000 is alloted during the fiscal year of 1918. At the beginning of the year the total permanent staff of the department is such as to require an expenditure for salaries of $900 per month. In addition there are fixed charges amounting to $100 per month which includes heat, light, power, rent and insurance. The total continuing expenditure is $1,000 a month or $12,000 a year.

This expenditure is indicated by drawing a line from the origin at *O* to the $12,000 point on the line *AB*. This will be drawn as a dotted line since the expense has not yet been definitely incurred at a fixed rate, being subject to change by shifts, promotions and resignations in the personnel.

On January 15, a new testing machine is purchased at a cost, including installation and delivery, of $500. This is a single expense and when considered as a charge against the appropriation is complete on the date incurred. It will, therefore, be shown as a vertical straight line having a length equal to $500 of the vertical scale, and will be drawn from the point at which the first line drawn intersects the date line January 15. From the upper extremity of this vertical line we draw in the new continuing expenditure line, dotted and *parallel* to the first such line drawn, since the continuing expenditure is at the same rate.

On February 18, a new man is added to the force. His salary being $2,000 per annum, our continuing expenditures rise to the rate of $14,000 per annum. The continuing expenditure line is, therefore, broken at February 18, changing its slope so as to lie *parallel* to a line drawn from *O* to the $14,000 point on *AB*.



EXPENDITURE AND BALANCE CHART FOR APPROPRIATIONS

Every purchase or construction expenditure which becomes a charge only after delivery of the machine or completion of the work, has the effect of displacing the graph, upwards, while every variation in the continuing expenditure has the effect of changing the slope of the graph. If the last continuing expenditure line drawn is prolonged until it intersects the line *AB* of the graph, the amount of the appropriation which will have been expended at the end of the fiscal year, if the continuing expenditures maintain their existing rate, can be read off at once on the line *AB*, assuming that no further purchases are made. The executive using the chart may, therefore, tell at a glance by visually prolonging the last inclined line drawn, whether or not the current rate of expenditure is a safe one. If the last line prolonged cuts the line *AB* above the limit of the appropriation, it is in effect a danger signal, and a warning that expenses must be diminished. Failing this, provision must be made somehow for increasing the allotment for the year.

Such a chart has the great advantage over the ordinary fiducial accounts that it shows not merely existing conditions but also the results which will ensue if those conditions are maintained. Furthermore, the relationship between the various kinds of expenditures is shown with a fullness and compactness which a plurality of written accounting statements cannot afford.

Organizing to Produce Shell Forgings

Factors That Must Receive Attention, and Plans and Methods That Have Already Proved Successful

By F. E. Merriam

Only a few firms in the United States have made a success of producing shell forgings, an important item in munition manufacture. This article takes up a number of points that must be carefully considered in forging shells, including handling device for bar stock, conveying machinery and elevators for the billets and forging, manufacturing processes, inspection, upkeep of machinery, standardization of tools and maintenance of labor. The counsel is given "to make haste slowly."

Mr. F. E. Merriam *is a mechanical engineering graduate of the University of Maine, and served as special apprentice and shop engineer of the plant of the Westinghouse Machine Company, East Pittsburg, Pennsylvania. For several years he has been connected in various executive capacities with the American munitions and war materials industry. He is at present with the Gulick-Henderson Company, Consulting and Inspection Engineers, New York, New York.*

THE present military success of the Allies is largely due to their superiority in artillery and munitions, and as the United States comes to take a more active part in the war it will be necessary for more and more of our manufacturers to take up the manufacture of shells, which must be produced in almost unthinkable quantities. In the case of most shells forgings are necessary; but only a few firms have had experience in this work, and fewer still have worked out the process to a point where their methods even approach the best practice. Those firms which thoroughly understand the business have attained success only after much costly experimenting and a close attention to every detail. This article does not aim to cover all phases of shell-forging manufacture but only points out some of the important features of organization necessary to success.

One of the very necessary parts of the organization is the inspection department, which, if properly managed, will be found to be increasingly important and useful. The inspectors must keep constantly in touch with the quality of the product and make inspection as rapidly as the forgings are completed and to be of the utmost usefulness the inspector must be armed with sufficient authority to make the necessary changes at the presses when the quality of the product falls off. The central feature of the inspection must be to follow production so closely as to render impossible the making of more than a few defective forgings before the trouble is discovered.

Thorough Need of Inspection

The attainment of this ideal requires that a considerable percentage of the forgings be given a thorough and complete inspection; this number should be at least 15 to 20 per cent. Small size forgings can be cooled in water and then tested, but the larger sizes must be inspected hot. For this work suitable gages must be devised which will not be quickly ruined by the heat and they must be so set as to allow for the contraction which will take place when cooling has occurred. The most common defect found in shell forging practice is eccentricity. It is against this fault that the forging inspector must constantly guard. To gage accurately for this feature some form of eccentricity gage must be provided. This should be of such a design that the forging can be rotated, since such a motion will closely reproduce the turning operation which will afterward take place. The manner in which the forging is held in the gage is important and should be similar to that employed in turning.

The centering of the closed end of the forging is also an important operation, and care should be taken that the gaging for eccentricity be based upon the same principles employed in this operation, as well as all others which have any relation to turning. In these finishing operations the forging is usually held on an expanding mandrel which grips it on the inside near both the closed and open ends. The eccentricity gage should give as close a reproduction of this method as possible. Tested in this manner the turning operation on the shell will come true with the inside, inspection will be dependable and the machine-shop rejections for forging defects will be reduced to a minimum.

Such a system of inspection should not be started unless the management is willing to give it complete backing, for the machinery will be shut down more often than before for the replacement and adjustment of tools, and there will be great opposition before all concerned are convinced of the merit of such rigid inspection. However, if the system is sternly enforced its merits will rapidly become apparent to all, for the percentage of rejections will decrease and exact knowledge of what is being done will replace the former lack of information. The writer has seen the percentage of rejections reduced by this system of inspection from over twenty to less than four per cent. in a very short time. The cost of operating such a system is very small and is justified many times over.

The necessity for highly standardized operations in the machine-shop requires that the forgings be uniform in size and quality if economical operation is to be secured. Therefore, very small variations become of importance. The forging inspection department must keep in touch with occurrences in the machine-shop and adjust the inspection accordingly, with the view of constantly reducing the loss. The inspectors should also see that the rejected forgings are segregated according to their heat numbers and cause of rejection, and arrange for their disposition as rapidly as possible. Such an inspection department will relieve the shop foreman of much work, leaving him free to devote his time and thought to the problems of tooling and production organization.

Handling Material

The handling of material commences with the steel in the form of bars. These must first be unloaded from the cars and stacked where they will be readily available for use as needed. A crane equipped with a magnet is undoubtedly the most efficient and satisfactory way to handle this steel; and at least a crane should be used even if the magnet is not available, for manual labor on this job is exceedingly slow and unsatisfactory from every viewpoint. Furthermore, if a magnet is not available the bars must be piled in such a way as to allow the lifting chains to be placed readily around the material, this adds to the cost of handling. Second, the bars must be moved to the cutting off device. For this a crane will be found to be the most economical, particularly if equipped with a magnet. After the bars are cut into billets it is usually best to stack the pieces in boxes, or similar receptacles, to facilitate their handling which can best be by crane. For the best results it will be necessary to keep a considerable quantity of billets in stock. This can easily be done by stacking the boxes in an isolated portion of the shop.

As rapidly as needed the billets can be brought up to the furnace for heating and forging. After forging, and while still hot, the forgings should be stacked in boxes, thoroughly covered with ashes and kept in this condition until cool. In case a greater degree of softening is required it will be necessary to carry out a regular annealing operation. For this process some form of continuous furnace is most desirable. After annealing it will be necessary to induce slow cooling by packing in boxes with ashes or other similar material. During cooling the boxes should be stored in an isolated portion of the shop and near to a place where they can be conveniently separated from the ashes after cooling. To separate the ashes and forgings the contents of the boxes should be dumped upon screens which will effectually separate the forgings after which they are ready for presentation for inspection. This is such a dusty operation that it will be desirable to keep it separated as far as possible from all other work.

But a little handling will be required for the company's own inspection since the inspectors examine the forgings immediately after they leave the presses. If the purchaser has inspectors at the shop much handling will be necessary in connection with their inspection and a determination of the most economical method will be necessary if proper costs are to be attained. The solution of these problems can well command the best talent available. After inspection, including segregation into different classes, storing and loading give opportunity to economize. Here is one of the big problems. Without systematic methods of handling, production cannot go forward properly.

Conveyors and Elevators

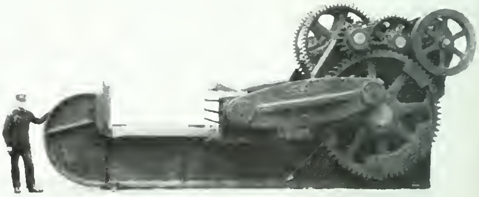
The large quantities of forgings to be shipped and loaded necessitate well designed and thought out apparatus such as conveyors, hoists, etc., as well as the management of the labor. Gravity conveyors are convenient and efficient for placing in the cars since they can be set at the proper grade to bring up the forgings as fast as they can be handled by the men in the car. The methods of getting the forgings to the conveyor will vary with the conditions such as the relative elevations of the car and shop floors. Some forms of elevators are adapted for this particular situation. In any case something better than manual labor must be employed if congestion and high costs are to be avoided.

Shipping and loading records must be carefully thought out and planned if a true and comprehensive knowledge is to be available at all times. Accurate records must be kept of the quantities accepted for shipment as well as those shipped and, often it will be necessary to further subdivide by heat numbers. If this subdivision must be made it will be necessary to exercise care to prevent their becoming mixed. The records should be checked daily with those kept by the purchasers' representatives and any disagreement adjusted and corrected at once, before the facts are forgotten. The care and maintenance of these records should be entrusted only to responsible parties who can, and will, appreciate their importance and exercise suitable diligence in their compilation.

INTERIOR VIEW OF SHELL FORGING SHOP

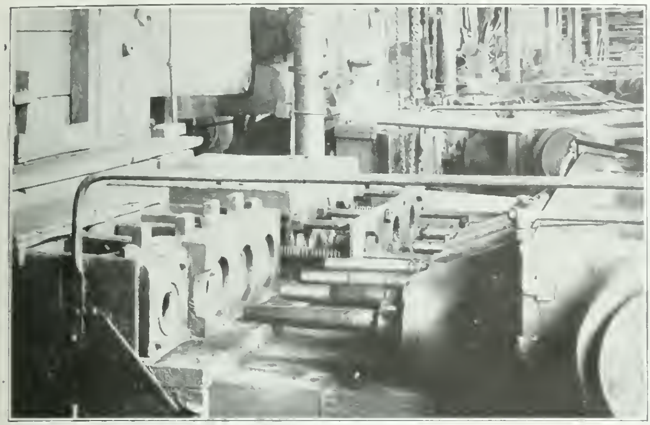
Processes for Cutting Billets

In many instances it will be necessary to purchase equipment for making the bars up into billets and the choice will not only depend upon the rate at which the apparatus can operate, but also upon many other matters. Shearing is undoubtedly the most rapid method when the steel is of the proper quality, but often it is not shearable and the larger sizes of bars are beyond the capacity of most, if not all, shears. The nicking-and-breaking method is practical for all sizes and qualities of steel used for shells, and in view of the usual ruling calling for the inspection of the billets for pipes and other defects this process will undoubtedly become standard since it is rapid and furnishes an excellent surface for inspection. On the smaller sizes a sharp nick about one-quarter-inch deep is sufficient. The billets can then be broken off with a blow from a heavy sledge. Sawing is much slower than either of the methods just mentioned and, in view of the inspection requirement, is not likely to be feasible in most instances.



BULLDOZER SUITABLE FOR FORGING SHELLS
Courtesy Williams-White & Co., Moline, Ill.

In most plants hydraulic presses are used in manufacturing forgings, but large motor-driven bulldozers are also successfully employed on this work and are producing excellent forgings. For making forgings larger than five-inch the bulldozers probably would not be a success, but in the smaller sizes they well deserve careful attention from anyone equipping a plant. The bulldozer being horizontal offers the advantage of easy handling of the forgings between the different operations since the men can stand upright and do not have to hold the work at arms' length. They can always stand in an easy position. While at work they stand above the die space. The illustrations of the bulldozers with the tools in place show how this works out. The one of the 1600-ton hydraulic press (on page 197) shows a machine not designed primarily for shell-forging work, but successfully adapted to it. The choice between bulldozers and hydraulic presses will depend upon many local conditions as well as price, deliveries, etc.



TOOLING FOR BULLDOZER AS USED IN FORGING SHELLS

Maintenance of Machinery

The maintenance of the machinery is an important item. It will be necessary to provide spare equipment to permit repairs to be made without interfering with production, and spare parts must be kept in stock ready for instant use. The machinery should be systematically overhauled and not allowed to run so long as it will hold together, since the systematic policy will result in minimum repair bills and more continuous service. The machinery must be kept in adjustment at all times, aside from that which it receives during the general overhauling.

The nature of the press tools will depend upon the manner of performing the necessary operations and their number, the nature of the equipment that will be used, etc. For example: Some firms use one operation and some two or even more, while some firms use hydraulic presses and others bulldozers. After the principles have been decided upon there will remain the working out of the details of design, class, kind and quality of material. None of these should be of a temporary nature since the service is severe, manufacturing costs high and replacements expensive in both money, time and production. All these features will, of course, require determination by experiment as well as by study. During the course of the work accurate records should be kept of the performance and changes made in order to place the choice of materials and design upon a definite basis. One important feature often overlooked, is the method of aligning the tools in the press. This, if well solved, will save much time and attendant delay in production, as well as resulting in a reduction of the costs. Another feature in the design requiring close attention is the matter of manufacturing the tools. These should be as simple as possible to bring low tool costs and rapid manufacture.

Maintenance of Labor

The human element is the most important single factor in the operation of any plant, and since conditions in a forge shop are naturally less pleasant than those prevailing in many other shops the management must give special thought and attention to the physical surroundings if a high-grade working force is to be obtained and the labor turnover kept at the minimum. The shop must be kept as clean and orderly as possible — such conditions make for high-grade workmanship and contented employees. To this end all material in process must be neatly piled, all refuse placed in receptacles provided for that purpose and regularly removed, machinery must be systematically cleaned and all passageways kept unobstructed.

Leakage of water from presses is not entirely preventable, but in most instances can be greatly reduced if a serious attempt is made. Spilling and scattering of oil should be given close attention for the sake of economy as well as cleanliness. Smoke is a major cause of the filth found so often in forge shops as to be almost considered a necessity although, as a matter of fact, it indicates nothing more than uneconomical and incomplete combustion. A careful study of this situation will result in the working out of methods that will mean greater fuel economy and more desirable working conditions. Smoke cannot be entirely eliminated where coal is the fuel, or even oil. On this account properly arranged hoods should be over the furnaces and these will effectively remove much of what remains. Frequent window cleaning will cut lighting bills and improve the surroundnings. In warm weather something should be done to alleviate the high temperature conditions usually prevailing. The hoods already mentioned will be a step in this direction and shields can be set up to protect the men from the direct heat of the furnaces.

Suitable wash rooms equipped with hot and cold water and shower baths should be provided so that the men can clean up, and not be compelled to eat their lunches and go home just as they come from work. Locker rooms will, of course, be necessary and it is well to provide a clean and well lighted room where the men can eat and rest during the noonings. The central thought is to remove the objectionable features so often connected with forge-shop work and to mitigate as far as possible any that cannot be removed. Such improvements are not philanthropy or extravagance but true economy because they promote efficiency.

Standardized Methods and Tools

The large scale on which shell forgings are finished demands highly standardized methods and processes, and workmanship to very close limits. Thus the tools must be finished with greater care and to much closer dimensions and limits than is necessary in forge-shop practice. Such matters as the alignment of the press and tools must receive careful attention, and the handling of the forgings from first to last must be carried out in a new and unaccustomed manner if success is to be attained. Ideas as to what constitutes excessive scale must be reconstructed, when working to such close dimensions only a very slight scaling is permissable. To this end unusual care must be exercised to prevent scaling in the furnace and before the billet is worked any scale present must be carefully removed The inspection already mentioned must be thorough and frequent and will keep the shop on the right track.

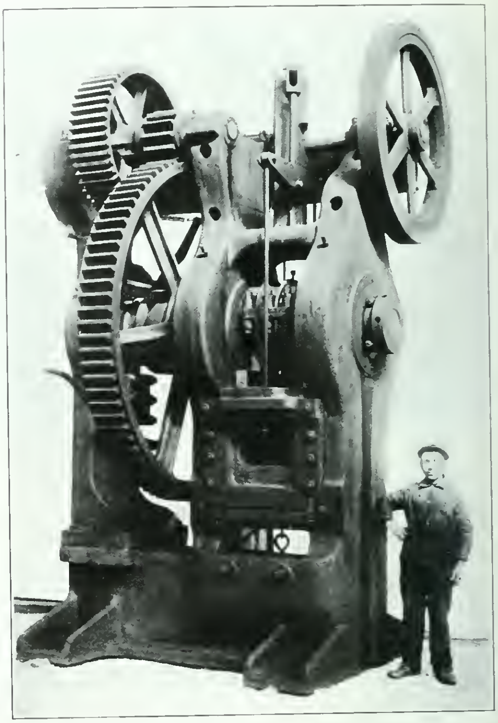
Some forgings will be produced that will not be acceptable as first class since to finish them would require deviation from standard methods. These can, however, be used with but little sacrifice of profit if proper salvaging methods are put in force. This work can be handled in two different ways, both being effective, the choice depending upon the condition of the forgings and the facilities available. Some can be most economically saved by reworking in the presses with an upsetting and redrawing operation or even, at times, by redrawing alone. In other cases a special machining method must be used. This sometimes consists of a turning operation or the forging being roughed to a much smaller size than is practicable on a large scale, while in other instances resort must be made to a special centering on account of eccentricity.

Whether the forging manufacturer should equip to do the special machining himself usually depends upon the terms he can make with the finishing shop. The finishing shop being necessarily equipped for such work a favorable arrangement can usually be made which will consist of an allowance for necessary extra work. In some instances it will doubtless be best for the forge shop to equip to handle such work for it will doubtless save some forgings that the finishing shop would not care to handle even under such an agreement. In this case the forging manufacturer will carry the work to the point where finishing can be completed by the standard operations. The finishing shop will then make an allowance for the operations completed. Since nearly all of this work will consist of turning and boring, very little machinery will be required to perform the work in an economical manner, but it should be borne in mind that on account of greater experience the finishing shop can often perform this work economically and, may not, on this account, be willing to allow enough to cover the cost incurred by the forge shop. Success in reclaiming forgings is dependent upon the knowledge of finishing and the ingenuity of those in immediate charge. The question will, of course, arise continually as to whether a particular forging is worth saving, but after some experience is gained this can become a matter of definite knowledge and record and the proper decision will not be hard to reach. Salvage work should keep pace with production to keep all matters up-to-date, and to make possible definite knowledge of the financial status of the order at all times. The fact that a forging has been saved is not necessarily proof that the transaction is a financial success, for the methods employed may cost more than the value of the forging. Accurate cost records must be kept and a degree of care and attention given equal to that devoted to production.

Disposal of Scrap

In all shops there will be some forgings that are absolute rejections and cannot be saved by any method. For these the proper course is to consider them as scrap at once, and sell them as such at the best possible price crediting the order with whatever they will bring. After a short experience such forgings can be easily determined and then the only reason for holding them is to secure a better price for the material.

At the finishing shop there will be rejections for various causes and some will be attributed to defective forgings. The wisdom of prompt decision and action was never truer than in this case, for justice cannot be done to all parties unless a settlement is made while the facts are available. On many orders handled in this country during the last few years this has not been done and there are many who can testify to the impossibility of making any equitable adjustment after a considerable period of time has elapsed. This matter should be cared for at least every week, for then all necessary facts can be secured and a proper adjustment made. The adjustment will consist of assumption of responsibility by the forge shop for forgings not up to the accepted standard, and by the finishing shop of all spoiled during machining. Often forgings have been machined to a point where it is demonstrated that they cannot be finished by standard methods. In this case it will be profitable for the forge shop to pay the additional cost of finishing rather than accept absolute loss. Careful cost records must be kept if a wise decision is to be made and financial loss avoided.



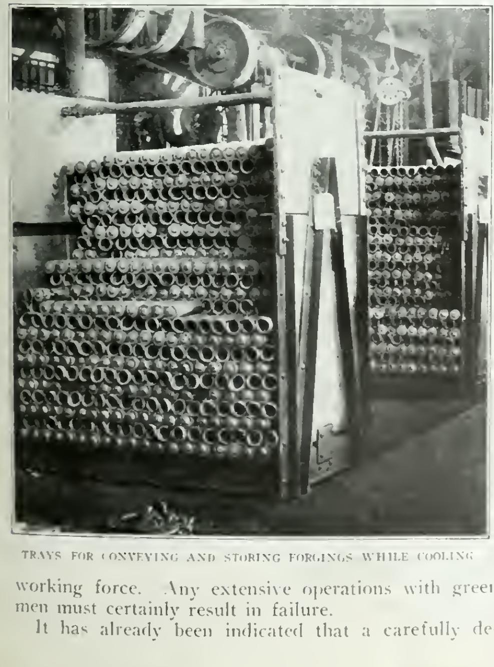
TYPE OF SHEAR SUITABLE FOR SHEARING FORGING BILLETS
Courtesy of Williams-White & Co., Moline, Ill.

Make Haste Slowly

The desire for production at the commencement of an order for the purpose of making a showing must not be allowed to outrun judgment, or the manufacturer will soon find himself with much spoiled material on hand, considerable money spent on useless tools, besides labor losses. Mistakes will be made and it is impossible to go slowly enough to avoid them entirely, but here, as elsewhere, good judgment must be exercised. If the shop is without experience in such work progress will be slow at first, even if experienced men are brought in. Many methods and tools will be found satisfactory for producing small quantities of forgings but unable to stand the test of large production. Materials and grades of materials must be tried out before acceptance and extensive use, for daily wear and tear will be found to deteriorate everything in a most surprising manner.

Production must be started in a small way at first and as experience is gained and men trained it can be increased. One of the most difficult things is to secure men and train them. On this account every reasonable effort should be made to retain them once they are trained. After a few men are trained they can be distributed and help in the process of building up the working force. Any extensive operations with green men must certainly result in failure.

1600 TON HYDRAULIC PRESS SUITABLE FOR LARGE SIZE SHELL FORGING
Courtesy of Williams-White & Co., Moline, Ill.



TRAYS FOR CONVEYING AND STORING FORGINGS WHILE COOLING

It has already been indicated that a carefully designed and operated cost system must be built up if the value of any of the methods or appliances is to be determined with certainty. Not only must such records be kept but they must be strictly up-to-date at all times, for if allowed to go far behind actual events they are of but little use, and will probably not be worth the expense incident to their maintenance. A concise statement of the financial standing of the order should be made up at least monthly. This cannot be done unless all adjustments and classifications both within and without the shop are kept up-to-date at all times. Only by the use of such a record can the present be accurately appraised and future policy definitely planned.

The purpose of this article has been not to outline the proper method of managing any particular shop, but rather to point out some of the items that must receive careful attention if success is to be attained, and to indicate how such problems have been successfully solved in different shops. The handling of a large order for forgings requires an entirely different point of view than that called for in ordinary forging work, on account of the degree of specialization required. So inspection, maintenance, welfare and many other factors must receive the same degree of attention, thought and planning ordinarily accorded only to production and tooling to achieve success in the long run.

Propaganda in Industrial Relations

By L. L. Warren

General Manager, Business Dept., Sherman Service

TODAY, as never before, appears the real need for organization. The world is learning the need of it; the United States knows it must first attain a right organization or efficiency will be sadly lacking. It is organization that must come first—planning, coöperation, standardization, effort, everything rests upon organization.

Mr. C. E. Knoeppel has, to my mind, properly interpreted the word when he says in the January issue: "*Organization is the proper relationship of human beings.*" He pleads with industrial executives to study, to think of these vital laws of association, and any man, who is connected with industry so that he knows anything of the facts concerning labor, can scarcely keep from yelling himself hoarse in trying to make men think NOW.

When organization is mentioned it is usual for the mind to turn quickly to unionization as it relates to labor. But the real meaning is far different. It first rests upon individualism. As we can point to everything artificial as coming from the results of physical effort, it is right to think that the laborer and his work are the causes of a *thought brought into realization* and vitally concerned in the analysis. Without labor we cannot have industrial organization, and it is only upon the human element in labor that I desire to dwell.

Ask any executive as to the *individual production* of his workers today in comparison to a year or two ago, and you will be surprised at his answer. I am being told almost daily that the decrease amounts to 50 per cent. in many instances and 25 per cent. in many more. Surely efficiency has not gone backward during this period; surely organization has not diminished to this degree. Nevertheless, the fact is there just the same.

Some Things Beside Business

Executives have been pitting their wits against competitors, mind against mind, for so long that they have forgotten there is something besides commercial business in life—something besides gain, something besides power and financial strength. They have thought of labor as a necessary evil, a thing to be dealt with and considered only so much as necessary. But "human bein's is human bein's" whether they sit behind the mahogany or work with a shovel. The sooner we realize this the better. The only difference is one of knowledge made up of experience, ability, thought. Trench life has proven this to be true; a month there, and all men are equal.

Labor wants a square deal; employers want a square deal. Each really desires the other to have a square deal. But neither knows what a square deal is, and, furthermore, in many instances they do not try even half-heartedly to determine. Individual inefficiency is the result. Strife is easily started, agitation results in demands which are impossible for employers to meet. Strikes result, and whether they win or lose, the workers think discord through unionization the only remedy.

Wages Not Based on Living Costs

By performing a certain amount of work every day a worker naturally expects the same amount of food, shelter and clothing every day; but the necessaries of life are not, or have not been, based on wages. As a result the cost of living increases faster than wages. Increases in the wage scale are seldom granted without demands. Strikes seem to be the only weapon, and so labor is convinced that agitation is profitable. No matter how much the individual production of a worker increases, his income does not meet the increased cost of living. How in the world can he be satisfied? Surely no executive would allow his business to run at a loss for very long without a radical change. Why should a worker be differently minded?

Individual production cannot be efficient unless the worker is contented, unless he is earning enough to "get by." My first step in employing a representative is to know what his cost of living amounts to each month. If I cannot pay him enough salary to make ends meet, I know that he will not be able to give me the best that is in him. If I can grant him that amount to begin with, I know that it is "dollars to doughnuts" that he will work constructively, actively, because he will be looking toward an advanced income where he can enjoy a few more of the better things of life and lay aside something for a rainy day. Welfare departments are supposed to do this very thing, but many times they work backward. They act on investigative data, but do not know the workers' thoughts.

You Must Know Workers' Thoughts

You must know the thoughts of workers if you are to treat them right. You must know their desires, their home environment, their relaxations—everything about them. Then, and only then can they be taught to know that you want to give them a square deal. It is through education that you can standardize their living—it is only through practical demonstration that you can prove them wrong in the belief that strikes pay, and that you are not a dishonest employer. The question naturally arises, "Am I expected to grant every wish of employees?" Absolutely no, they don't expect you to do so, human nature is not constructed in that manner.

Your workers are no different from yourself. You like your job and they like theirs. Investigation has proven that more than 90 per cent. of workers are loyal. If they become a party to strife it is owing to mob-spirit. About five per cent. of employees are semi-loyal because of the fact that they have advanced in mentality beyond their present responsibility, something is wrong but they do not know what it is. The balance are from three-quarters to wholly disloyal.

Strikes and Losses

The usual methods which have been adopted by employment departments have been for the quick discharge of the disloyal ones. As a result of such an action there have probably been thousands of strikes which caused millions of dollars of loss. The reason these individuals are leaders is because of their being of greater mentality in comparison to their associates, therefore, they are close friends as a rule, and when discharged have a following that is surprising.

These disloyal workers can be taught, can be given better places or found places where their desires for more money can be gratified if they will devote their mind to production and not to strife. All they want is money and they can be taught that they must work to earn it. All their disloyal utterances can be successfully refuted if proper means are used. Every word they have with the contented employees simply pulls down the individual production of everyone. The same effect oppositely directed will cause an opposite result. But it has not been done, demands have been formed, made and strikes caused which have cost millions, without one single word spoken to offset the arguments.

Workers have been told what has been gained through strikes, but have you told them—mind you, I mean *told them*—what the losses have amounted to? Do shoe workers as individuals know actually how much four months of idleness upon the part of 15,000 workers, with no benefits, cost those workers in Lynn last Spring? Do shoe workers *know* that more than $4,000,000 went beyond recall? Why? The real reason, I believe, was a fight between two unions more than anything else. Do all the street car workers know how much the real loss was in the street railway strike in New York in 1916? Do coal miners know what the anthracite coal strike of some years ago really cost miners as individuals? Mr. Stevens has told of the lost days from labor disturbance in the shipyard since April. Do workers individually know?

Apply a Knowledge of the Mind

Now it is individualism that must be considered—and what is the answer. To my mind, and I am sure there are others likeminded, it is psychology—nothing more nor less than a classified knowledge of the human mind, of the mind of every worker.

The easiest way for me to make myself plain is to use our Hunnish enemy as an illustration. We have seen and are seeing what terrible havoc can be brought about through psychological effort in binding a people together, in building up individual production, in disrupting the morale of outside nations and in forcing a people to believe that right is wrong and wrong is right. We are seeing our ammunition plants blown up, our factories fired, and continuous attempts to spread throughout our nation a propaganda that is the opposite of good; all this through forcing a wrong thought, a barbarous idea, and as a result of psychological effort, promoting through a knowledge of the human mind the dirtiest, filthiest activities there have ever been seen.

Every worker today can be made to know his duty to his country, to himself and home by psychologically planned propaganda. It is the only way to bring him to full consciousness of facts, and as he responds to suggestion through contact, employers must reward his increased effort, must see that enough money is paid him to buy enough food, clothing and shelter.

The Economy of Centralized Trucking

How One Plant Saved $50,000 a Year Through Organizing Its Factory Trucking Forces

By J. M. Van Harlingen

Factory trucking should be considered as a productive function to be controlled and supervised as carefully as any other, instead of being looked upon as an unavoidable source of expense to be slurred over as easily as possible. The centralizing of the trucking in the plant of the Fisk Rubber Company, Springfield, Mass., under one department, including the operation of the freight elevators, has brought three major results: Utilization of equipment to maximum capacity; reduction of the trucking force by some 60 to 75 men resulting in a direct labor saving of $50,000 per year; standardization of equipment to facilitate the handling of work and reduce maintenance costs, an additional saving of $5,000 per year.

Mr. J. M. Van Harlingen, *after being graduated from the Sheffield School, served four years as apprentice engineer and assistant supervisor of the Public Service Railway Company; later was manager of the Transportation Department of the International Motor Company for two years; then assistant to superintendent of the New England Westinghouse Company one year. At present he is special assistant to the works manager of the Fisk Rubber Company, Springfield, Massachusetts, dealing with problems of factory organization and industrial economies.*

ONE plant is today saving at the rate of $50,000 a year through a centralized trucking department. For three months before this department started operations, the conditions were studied and the field mapped out. The work was taken over gradually, and trucking in each department assumed only after operations in preceding departments had been completely organized. See Figure 1.

The trucking force in thirty departments consisted of about 175 men, most of whom were hand truckers operating every variety of equipment, each department foreman controlling his own group. In addition to these men there was the nucleus of a trucking department consisting of five electric industrial trucks operated by the maintenance department as a part of their general plant service. These trucks were used wherever unusually heavy moving was to be done, and occasionally their services were charged against the department for which the work was handled, but by far the greater amount of expense incurred was absorbed as overhead by the maintenance department.

Operation of the Elevators

The first observation which was made on plant trucking was centered about the delays. These were constant and appeared to be a natural consequence of the layout of the plant. Many were caused by elevators and it was apparent that little or no attempt was being made to regulate elevator operation or the traffic handled by them. Several studies (Figure 2) were made giving the traffic by trips and the actual time consumed. From these studies it appeared that any interdepartmental transportation system must depend for its success largely upon the coöperation of elevator service, and that it would therefore be wiser to have the operation of elevators as well as interdepartmental trucking controlled by the trucking department. This was done, and in practice our conclusion proved to be correct.

At the start the principal difficulty was with equipment. Five electric trucks were immediately taken over, three of which were of the elevating platform type and the other two of the stationary platform variety commonly known as the baggage type. It was obvious that there were enough hand trucks around the plant to more than care for the movement of interdepartmental work, therefore equipment was taken over from each of the departments as well as men used on the interdepartmental trucking. This plan was put into operation and was extremely successful. It was not realized at first to what extent the electric trucks could be used in connection with the large elevating platform, and we were immediately faced with the difficulty of securing enough of these platforms to carry out the schedule properly. The change from hand trucks with small loads to electric trucks with loads from five to seven times as large stretched the capacity of the small number of platforms to their utmost, and the work was hampered and the acquirement of more work delayed by the lack of platform equipment.

Platforms for Work

It was found that there was not in the plant a properly constructed platform that would withstand rough usage and heavy loads. Several types of platform had been used with the electric trucks, but each had proven costly to maintain. These original types cost about $7 each.

A platform was finally found, shown in Figure 3, which has proved sturdy and as light as is compatable with strength. It measures 4x5 feet, stands 12 inches from the floor in the clear and weighs a little more than 200 pounds. The first experimental platform of this type was subjected to very rough handling and as a final test it was thrown sideways on its legs from a four-foot platform to a cement drive; on the fifth throw one bolt pulled through the planking on top. Washers were then put under each bolt head, and as it now stands this platform will withstand very hard usage and will give good service. There is a corrugated steel platform made for heavy loads but it weighs more and, if damaged, would be hard to repair.

There was some question as to the proper use for the large platforms; it was found in all cases that for purposes other than permanent storage goods should remain piled on platforms until finally distributed or stocked, and that it is cheaper to provide platforms than to pay for the two handlings necessary for each transfer. It is not generally practical to use platforms for storage purposes. Following this plan the required number of platforms were assigned to each department or route, and these are used, except in case of great emergency, in that one service exclusively.

Hand trucking, which was 90 per cent. of all trucking under the old order, was done in a few departments by elevating hand trucks carrying small light loads, while other departments used either the traditional two-wheeled freight truck or special types of wheels. No attempt had been made to standardize and, through the system of borrowing which exists in most plants, trucks originally designed for a definite purpose were found far from their own department and utilized for odd jobs for which they were generally unsuitable. It was obvious that these trucks could not be taken out of service unless they were replaced by something else. To do this properly it was necessary to have some knowledge of what forms of truck were uniformally adaptable to a number of departments. A careful survey was made, thirty distinct types were listed and a brief description with outline drawings of each type made up for reference. See Figures 4 and 5.

During the first five months of its operation the department was occupied in "delivering the goods" and keeping the departments convinced that its service was adequate. After the first three or four departments' work had been done successfully the trucking department was solicited by others to take over their trucking.

In brief the results obtained by the trucking department are as follows:

1. Use of equipment to its maximum capacity.
2. Reduction of between 60 and 75 men in the force necessary to do the work, resulting in a direct saving in this item alone of $50,000 per annum.
3. Standardized equipment to reduce maintenance costs and facilitate ease of handling work. This item will be responsible for a saving of approximately $5,000 during the coming year.

In surveying the work of the first three months it was found that elevators had been regulated so that pleasure riding by employees was eliminated. A conductor had been placed on the large, important elevators and waiting time was almost entirely done away with. Before taking over the operation of elevators it was not unusual to find a wait of 15 minutes for ten or more men through the delays in service, and a desire on the part of the men themselves to kill time. It was found that operation of the two-gate type of elevator could be speeded up by arranging standard exits and entrances. Under the former plan of operation constant delays and confusion resulted through the efforts of truckers to enter and leave from the same side of the elevators.

PLANNING AND SCHEDULING

On the interdepartmental trucking it was found that the economic movement of goods necessitated a plan of operation and a scheduling of the needs in each department served, for without planning or scheduling trucking work had been done on a one-way load basis. With the co-operation of the departments served the number of empty trips had been reduced so that few trips are now made without a load. Trucks are assigned to certain routes and operate on a schedule dependent upon the needs of the departments served. Scheduling is, of course, a matter of policy with the production departments and we were fortunate in gaining this coöperation through friendly understanding. It is generally essential that in a large plant the operating departments arrange their production as scheduled, but it is frequently not considered so necessary to deliver raw materials and supplies on a regular routine. It may, however, be the means of considerable saving in trucking expense if this is done.

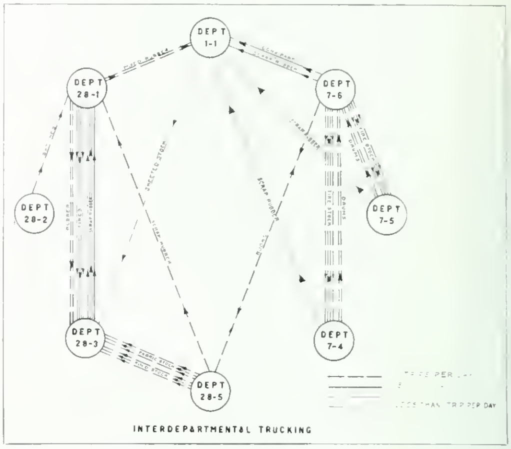


FIG. 1. CHART SHOWING INTERDEPARTMENTAL TRAFFIC

As a result of the first few months' operation the saving in both time and men began to be apparent. The following are among the more striking examples.

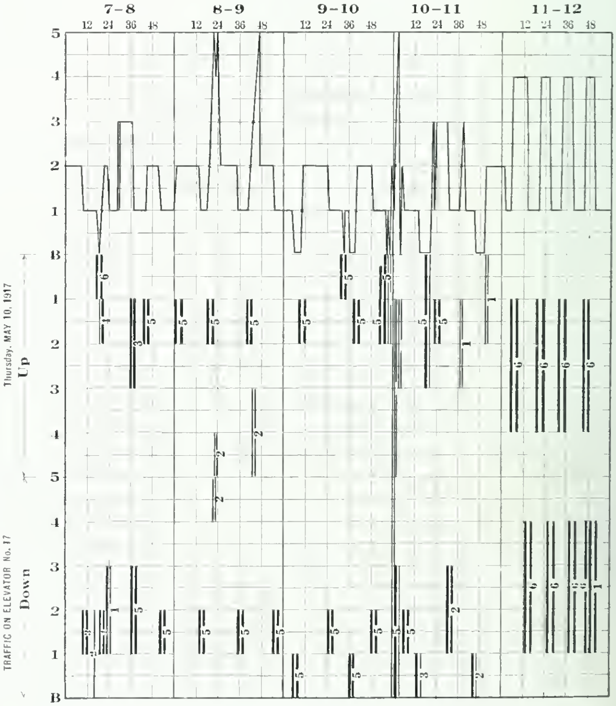


FIG. 2. STUDY OF A DAY'S OPERATION OF ONE ELEVATOR
This gives the time of each trip and delays at each floor, traffic between different floors, both up and down, nature and number of loads carried, and number of employees carried

CONCRETE RESULTS

A finished product had to be trucked in box trucks from one building to another over an inclined bridge. These box trucks had a capacity of 700 pounds and eight or nine trips a day were made with them. Five men were necessary to negotiate the bridge with this truck and they accompanied it through the entire route. Each trip took from half an hour to an hour and a quarter, an average of perhaps three-quarters of an hour. With the electric truck a box of 1,000 pounds capacity is used. One man places this truck on an elevator which takes it to the location where the electric truck picks it up. By this arrangement four of the men formerly used in this work are eliminated at a net saving of about $3,000 per annum, after deducting electric truck charges. This saving has been made in the face of a 20 per cent. increase in the production of the department.

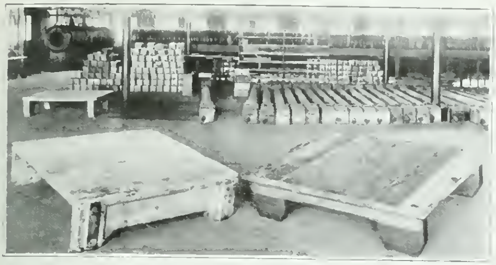


FIG. 3. TWO TYPES OF HEAVY DUTY PLATFORMS
Used by large hand elevating and electric trucks. The one on the right is the newer type and considered the best yet developed

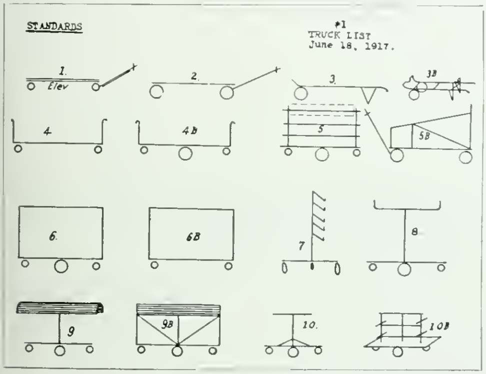


FIG. 4. ONE OF A SERIES OF CHARTS FOR CLASSIFICATION OF THE 35 TYPES OF TRUCKS IN USE

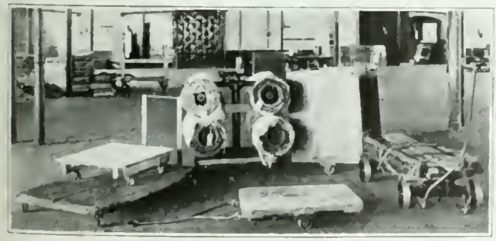


FIG. 5. A FEW OF THE 35 TYPES OF TRUCKS IN USE WHEN TRUCKING DEPARTMENT BEGAN OPERATIONS

Boxes and containers brought from stores were formerly trucked on small hand trucks as needed, each trip requiring an hour or more. Generally four trips were made each day. One electric truck with platforms now makes two trips a day and keeps this department supplied with boxes 24 hours ahead of its requirements.

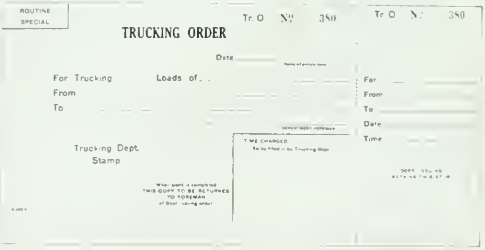
Components, formerly trucked by three men with small trucks from one department to another over a short distance, are now moved on large elevating hand trucks by one man.

In one department where 35 truckers were employed, all have been dispensed with in favor of two hand truckers and an electric truck devoted exclusively to this service.

These examples show in a concrete way what has been accomplished. There has also resulted from the close scrutiny of trucking expense a rather remarkable readjustment of labor in departments not yet affected by the operations of the trucking department. The reduction in trucking expense in these departments has been due to a feeling that reductions in the force had best be made by the department itself rather than by any outside agency. This condition would not have been brought about but for the establishment of and results obtained by the trucking department.

It is essential that in establishing a centralized trucking force some means be adopted for recording the work done and the cost of doing it.

In this case it was not feasible to establish a record of tonnage and it was therefore decided to have the performance reported on a time-and-trip basis. Later the length of trips were found to vary to such an extent that the trip record was discontinued and the trucks assigned to zones with a record kept of their time in motion. A chart of this record, Figure 7, showing the percentage of total day, in actual motion by months, is illustrative of the change that may be brought about by supervision. The average of the three elevating type industrial trucks during November was 75 per cent. while the two platform trucks average 45 per cent. during the same period. This comparative result is natural because of the time required to load and unload platform trucks while they stand idle.



ROUTINE
SPECIAL

Tr. O Nº 380

TRUCKING ORDER

Date

For Trucking Loads of

From

To

Trucking Dept.
Stamp

When work is completed
THIS COPY TO BE RETURNED
TO FOREMAN
of Dept. issuing order

TIME CHARGED

Tr O Nº 380

For

From

To

Date

Time

FIG. 6. STYLE OF TRUCKING ORDER USED

Alloting the Expense

The first question as to such service is, how should it be paid for and by whom ordered? This was settled by issuing the following order:

Routine Trucking. A department requiring routine trucking will fill out an order for each type of trucking or for each commodity to be trucked during a period of one week or less.

Single Loads. Single loads or single batches of equipment, materials or finished products will be moved on special order which will specify the amount of work to be done. All charges against a department will be based on these orders and such charges will be made on an hourly basis. The rate will be dependent on the actual labor cost and overhead for the use of electric trucks or hand trucks. Charges will be based on the amount of time actually used from the time the truck arrives at the department until the goods have been delivered at their destination.

The trucking department assumes no responsibility for loading platforms or trailers, except where trucking order calls for such service, and delays occasioned by waiting for loads will be charged against the department causing them.

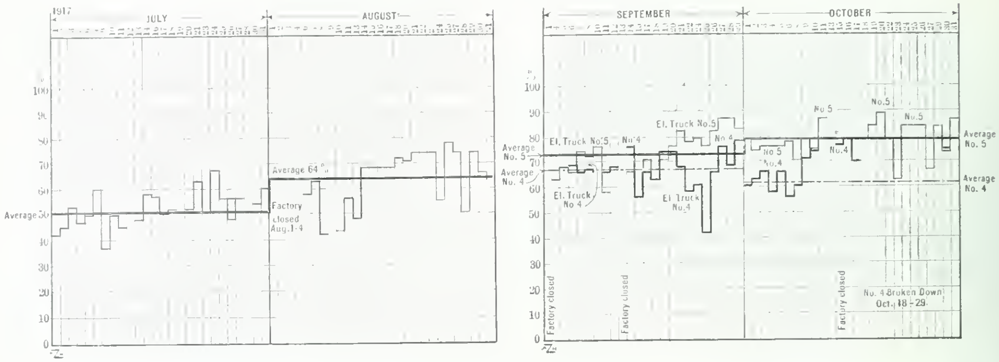


FIG. 7. CHARTS SHOWING RESULTS OBTAINED BY CLOSE SUPERVISION OF TRUCKING OPERATIONS
Each truck was equipped with a recording device to show "time in motion" and "idle time"

Making Out Orders. Trucking numbers will be numbered serially and will be made out in duplicate. The department foreman will sign these requisitions or delegate some one to do so for him.

No orders will be accepted without a signed requisition. In the case of emergency, telephone orders will be filled, and the requisition sent to the foreman for signature at the time the trucking is done. The foreman will give to the truckman both copies of the order, retaining as a check the stub from the original copy.

The trucking department will retain the original copy until the work is completed, and will then return it to the foreman giving him the amount of time charged against this order. The duplicate, which will be printed on heavier paper, will be retained in the trucking department where all the time charged against this order will be entered.

Cost Department. At the end of the week all trucking orders giving the total amount of time and the charge rate entered on them will be sent to the cost department as a basis for charging each department with the work which has been done for it.

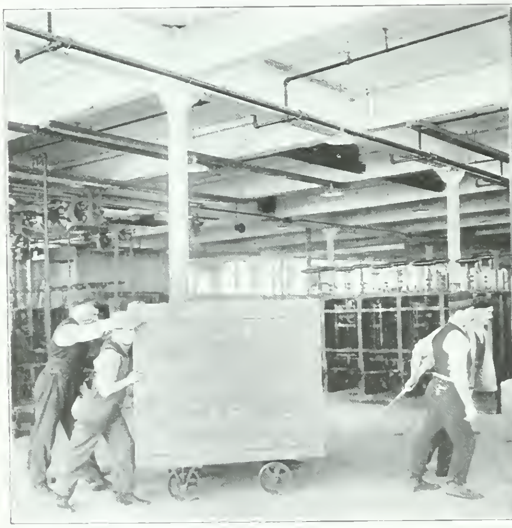


FIG. 8. FIVE MEN REQUIRED FOR THIS LOAD USING THE HAND TRUCK

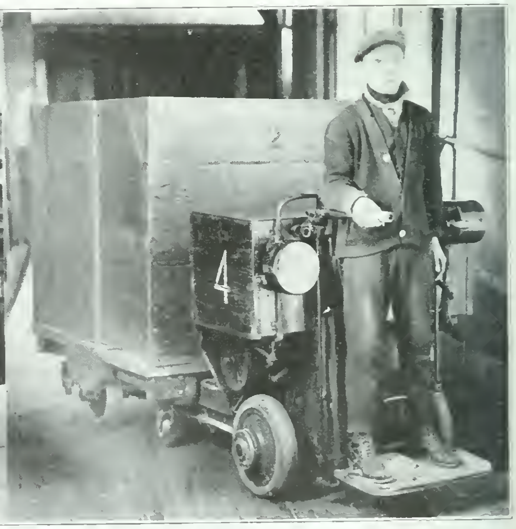


FIG 9. COMBINATION HAND TRUCK TRAILER AND ELEVATING PLATFORM DOING THE SAME WORK

This order form, Figure 6, was issued first weekly for routing work, but as the expense distribution was made on a monthly basis it was found to be better to make orders on the same basis which was finally done. Orders other than routine are handled by the same form, but each special order must be issued on this form and the cost charged against the order number. In order that the general manager's office may be kept in constant touch with the work, reports are made each day giving the amount of equipment working, the number of men employed, the breakdowns both on trucks and elevators. These reports with the exception of the breakdown report are made in duplicate, one remaining in the trucking office and the original sent to the general manager. The breakdown report showing mechanical defects and length of interruptions to service go to the chief engineer in charge of maintenance and equipment as well as the general manager so as to enable both to be fully informed.

Repairing Trucking Equipment

For the purpose of more accurate record it was decided to establish a card record for each piece of equipment in the entire plant whether used by the trucking or any other department. The trucking department is now responsible for the mechanical condition of all trucking equipment and it seemed advisable to establish some record for each piece of equipment. The advisability of making costly repairs on old equipment that has outlived its estimated life may, and should be, determined through a record of this sort. That little or no thought has been given to the matter of repairs was evident from the large number of hand trucks constantly in the repair shop. Many of these had practically to be rebuilt before being put back into service. The most casual examination showed that little care had been exercised in their upkeep, and many had been allowed to reach a state of dilapidation beyond repair. This was a case for further centralization and the trucking department finally took over the responsibility for the mechanical condition of the trucks. An inspector was put in charge of this work and given a small enclosure for storing and cleaning purposes.

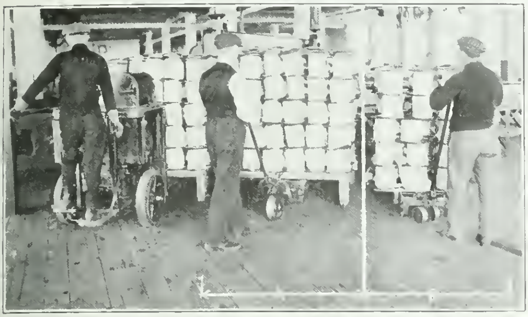


FIG. 10. HOW THE ELECTRIC TRUCK SAVES LABOR
These men with small hand elevating trucks as shown in B were hauling these drums before the new, large equipment A was introduced. Now one man does the work of three and electric trucks help where load must be carried some distance

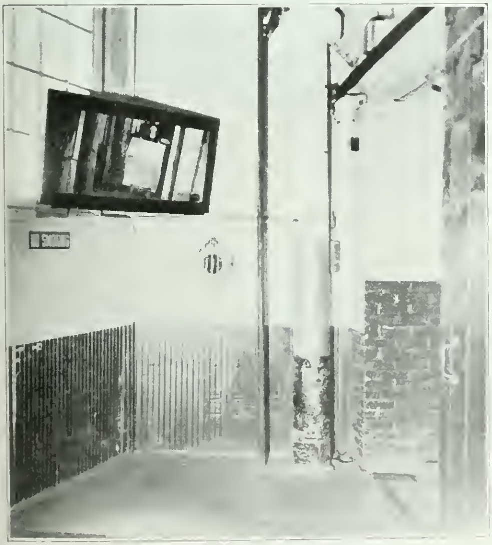


FIG. 11. SHARP RIGHT ANGLE TURNS PROTECTED BY MIRRORS

A large number of trucks with small wheels were being operated carrying heavy loads and it was decided that standard wheels should be adopted and all odd sizes eliminated. It was obvious that the wheels used were too small and that they were breaking floors, door sills and incidentally themselves under heavy loads. As it was obvious that larger wheels were desirable it was decided to establish a minimum of six inches for the smallest diameter of wheels to be used, and that wherever possible the size of wheels should be confined to six and eight inches for castors and ten and twelve inches for stationary wheels. The 12-inch wheels are to be universally equipped with either roller bearings or pin bearings, and the castors are to be finished both as to the bore of the hub and the pin.

Too much stress cannot be laid upon the subject of a definite mechanical supervision over trucking equipment. It was found that the hand truck, which under normal loads and proper maintenance will require one or two men to operate, may easily become defective to such an extent that one or more extra men will be required. This matter of mechanical repair and upkeep applies also to floor conditions.

Figures 8 to 11, inclusive, show a few features of the equipment. In each case the caption of the illustration is descriptive.

The successful operation of this department shows that trucking may and should be considered as a productive division of the factory organization, instead of an overhead expense, and that it can be controlled and supervised with as good results as any other department in a plant.

Work of the U. S. Forest Service

THE following extracts from the annual report of the Chief Forester contains the following important information and throws a great deal of light upon the activities of this branch of the government:

"In the work relating to forest utilization and forest products, the resources of the service have been employed to the limit of their capacity since the war began in rendering assistance to the War and Navy Departments, the Emergency Fleet Corporation, various committees of the Council of National Defense, and manufacturers of war orders. The peace-time program has been largely discontinued. The force and the work have been centered in Washington and Madison. Every effort has been made to bring available knowledge to the attention of the organizations which have need for it and to assist in anticipating their problems."

Tests of Wood

Approximately 10,000 additional tests of mechanical properties of various species of wood were made during the year, which brings the total number of tests of the character up to about 130,000.

Prior to the beginning of the war tests on methods of kiln-drying lumber were continued as in the past. A process was perfected under which hemlock shiplap can be dried to shipping condition with practically no loss of grade in 40 to 48 hours. Satisfactory results were also obtained with Douglas fir and white fir.

Coöperative Shop Gardening

How the Whitcomb-Blaisdell Machine Tool Company Organized A Farm Project for Its Employees

By Chas. E. Hildreth

The Paxton Potato Syndicate, organized by Mr. Hildreth's firm for the benefit of its employees, sold shares at $5 each and returned to each share-holder four bushels of potatoes. This tangible result was in addition to the developing of a splendid spirit of cooperation among all who had anything to do with the project.

Mr. Charles E. Hildreth, *after receiving his education at Amherst and in business became a partner of P. Blaisdell & Company in 1892. In 1895, he became Vice-President and then Treasurer of the Whitcomb & Blaisdell Machine Tool Company, and since 1915, he has been President and General Manager of that firm. He is a Director of the Worcester Electric Company, Trustee of the Worcester Five Cents Savings Bank, and a member of the corporation of the Worcester Mechanics Savings Bank. He has always been active in the counsels and affairs of the National Machine Tool Builders' Association, and for a number of years has been the Association's General Manager.*

WITH the first indications of a shortage of food, the Whitcomb-Blaisdell Machine Tool Company, Worcester, Mass., organized what was known as the Paxton Potato Syndicate. This took its name from the town of Paxton, six miles from Worcester, in which was a farm owned by Mr. William A. Blaisdell who had been for a number of years a stockholder in the above company. Mr. Blaisdell agreed to lease 20 acres of his farm and take charge of the planting, growing and harvesting for the syndicate.

Six hundred shares were authorized by the Whitcomb-Blaisdell Company and 400 shares sold to the employees in both the machine and foundry departments at $5 per share, and all the issued stock was taken up.

The stockholders then chose from among their number a committee of control, consisting of three from the machine shop and three from the foundry department. This committee, working with the president and treasurer of the company, directed and managed the syndicate. First, the 20 acres were thoroughly inspected by a representative of the State Agricultural Department, who advised on the soil and methods of cultivation. His advice was followed strictly. Much of the land was rank with witch-grass. Fertilizer was procured and put on, about one ton to each acre. About 15 acres were seeded to potatoes; two and one-half acres to beans; two-thirds of an acre to carrots; three-fourths of an acre to onions; one-eighth of an acre to turnips. There was produced a yield of about 2000 bushels of potatoes; 30 bushels of beans; 33 bushels of onions; 270 bushels of carrots; 76 bushels of turnips.

All the above crops were planted on the witch-grass land except the carrots, onions and about two acres of potatoes. These two acres yielded a trifle over 200 bushels to the acre.

This coming year measures have been taken to eliminate all the witch-grass and the 15 acres should then show a yield of at least 3000 bushels. An interesting feature of the witch-grass problem was the interest created in the farm among the men by taking them up in trucks after working hours and giving them the task of curbing the nuisance. The first night a load of 25 went from the foundry and the next night an equal number from the machine shop. When the foundry went next there were so many who wanted to go that it took two trucks and later three. The machinists

FARMING BY MACHINE SHOP AND FOUNDRY EMPLOYEES NEAR WORCESTER, MASS.

never took so kindly to the work as did the moulders, but this was only natural as the character of the work was much easier for the latter and sore muscles and lame backs not so numerous. The moulders made regular picnics of it, got up songs, yells, etc., and later acquired the habit of Sunday picnics at the farm; all of which created not only a lively interest in the project but a splendid spirit among the men. When the crops were harvested each shareholder received four bushels apiece per share which at the cost of $5 gave them their potatoes at $1.25 per bushel, which was under the market price at any time this season. This was the agreement made by the company whether they made on the project or not. To help make up the deficiency the men agreed to sell the remaining potatoes and other vegetables, giving their own number the first opportunity.

Now, although this will not entirely reimburse the company for the money invested, the management feels that the investment was worth more than the money and proposes to run the farm again this summer. With all the farming implements now purchased and the witch-grass problem out of the way, everyone looks forward to much better results in the coming year.

Shop Gardening as a War Measure

How Factory Employees Can Help Increase the Food Supply

By Luther D. Burlingame

Last summer there was a two-fold incentive to cultivate gardens: The nation's food supply needed to be increased, and the high cost of living was thinning the householder's pocketbook. The problem was to increase the production of food without curtailing industrial labor or drawing upon regular farm activities. The Brown & Sharpe Manufacturing Company fostered gardening among its employees with the satisfactory results outlined in this article.

Mr. Luther D. Burlingame, *Industrial Superintendent of the Brown & Sharpe works, served a drafting room and machine-shop apprenticeship with that firm and for twenty-six years was its chief draftsman. He is an active member of the A. S. M. E., chairman of its sub-committee on limits and tolerances of screw threads, and chairman of its committee on standards and measurements. He is a past president of the Providence Engineering Society and a frequent contributor to the technical press, including* INDUSTRIAL MANAGEMENT*; also a contributor to technical societies.*

IN the spring of 1917, when a plan of coöperation was presented to the employees of the Brown & Sharpe Manufacturing Company, Providence, R. I., the company offering to secure, fertilize and plow land for gardens if the men would provide the seed and cultivate them, the response was such as to leave no doubt of the willingness, in fact eagerness, of the men to do their part. The number desiring to cultivate gardens exceeded by several times the original estimates made by those who were sponsors for the plan, so that additional tracts of land, beyond what had first been planned for had to be secured to supply even a small garden for each applicant.

The land secured for these gardens was located in three different sections of the city of Providence, but in centers where many of the workmen lived. Some of the land was leased. In other cases its use was donated by public-spirited citizens or corporations (with hearts). The Retail Merchants' Division of the Providence Chamber of Commerce, as well as the Providence Recreation Board, delegated by the city to aid in this work, gave active assistance.

Over 500 gardens covering 30 acres of land were successfully cultivated under the supervision of the Brown & Sharpe Company. It is the purpose of this article to describe the methods by which the organization was perfected and the work carried on, hoping that the experience may prove an incentive to others to carry out similar projects during the coming season, and also serve as a guide to those that do so.

That such a movement can be well worth while is shown by the fact that the crops from these gardens returned produce to a value of approximatey $10,000, and added to the food supply about 4000 bushels of potatoes, 254 bushels of beans, 223 bushels of tomatoes, 5½ tons of turnips, over 2 tons of carrots, 3 tons of cabbage, nearly a ton of parsnips besides beets, squash, corn, celery, etc., in large quantities. The great variety raised was indicated by a remark of the clerk working on the job of tabulating the returns from the garden at the close of the season. After a hard day's work he said that he felt as if he had been having "boiled dinner" all day.

It will be noted that the crops raised were largely staples that the men could store in their cellars for winter use, and they are proving of material help to many a family during the present winter.

The carrying out of this enterprise also encouraged the cultivation of home gardens by employees and their friends so that the total results attained were very gratifying and far exceeded the figures given.

GARDEN CAMPAIGN OPENED

The campaign was opened by the posting of a notice, Figure 1, on the shop bulletin boards. Cards, Figure 2, were furnished to the clerks in each department on which the men could make application for gardens. The plot number was left blank on these cards until after the drawing by lot for location. In order that the men might secure gardens as near as possible to their place of residence, the plots were divided into several groups, and the gardens were assigned to those living in each neighborhood by drawing lots. After the drawing the number of the garden was filled in on the card, the required requisitions for fertilizer, and the seed that had been ordered, went through the supply department. What had been ordered was charged against the workman's account. He could then secure his supplies from headquarters at the garden. The supplies purchased in this way were obtained at wholesale prices, the men being charged only enough above cost to pay for the handling and accounting. A blue card, Figure 3, was made out for each gardener, with his name, address and plot number. This showed where he had been assigned, and became his official card to show that he or any member of his family carrying it had a right on his garden. This was one of the means used of protecting the garden against depredations, as these cards were requested to be shown whenever required, that it might be known that the worker was not a trespasser.

After the returns had been made showing which men desired to cultivate gardens, they were called together at a noontime mass meeting and general instructions and information given as to the method of conducting the work. A Gardening Club was organized with elected officers representing, so far as possible, different departments of the shop and different plots of land to be cultivated. While the general administration of the project was in the hands of the shop Industrial Department, the Gardening Club was consulted and asked to pass on many matters which had to do with the satisfactory carrying on of the work, thus giving the men something to say as to what should be done.

Need of Starting Early

With the shortage of labor and difficulty in securing seed, fertilizer, manure, etc., in the spring of 1917, it required heroic measures to get the garden project under way within a reasonable time. As a substitute for manure, which could not be secured in the quantities needed, although several carloads were obtained by shipment from Boston, street sweepings were utilized. This material combined with sheep manure and commercial fertilizer gave excellent results.

Much of the plowing had to be done with inexperienced help although a power tractor was obtained for a part of the job. The ground was staked with stakes 2 x 2 x 18 inches long into plots, each containing from 2000 to 2,500 square feet. The numbers of the plots were stenciled on all four sides of the stakes, and as they were set diagonally at the corners of the plots, the number of each plot showed at every corner. These stakes have been left in the ground for use during the coming season, so that those desiring to retain the same garden they had last year can do so and start work as early as they wish in the spring. This makes it necessary for each man to dig over the ground for his garden instead of having it plowed; not a hard task for a small garden as the ground, thanks to last year's cultivation, will thereby be in mellow condition.

Administration of the Gardens

A young man, a practical farmer who had had training in an agricultural college, was employed as superintendent of the gardens, to have general supervision and to give instructions to those who had not previously had gardening experience. A Satuday afternoon meeting was arranged just before the gardens were ready for planting, at which Professor S. C. Damon of the Rhode Island Agricultural College gave a talk and demonstration on the cutting and planting of "seed" potatoes.

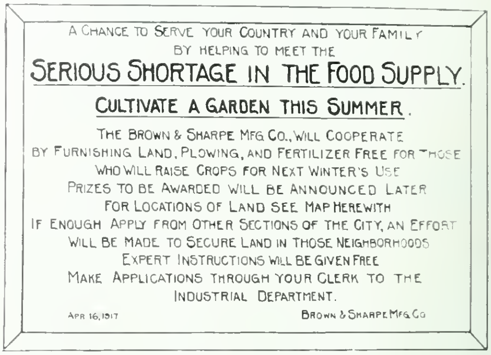
The large attendance and great interest shown at this meeting proved that the hearts of the men were in the project; in fact this was in evidence all throughout the undertaking to the end of the season.

Tool Sheds and Shelters

At the largest garden center a tool shed about 16 x 36 feet in size was erected where running water was available and a man placed in charge, so that tools could be given out on check. This building served as a shelter in case of storm, and for storing extra fertilizer and other material.

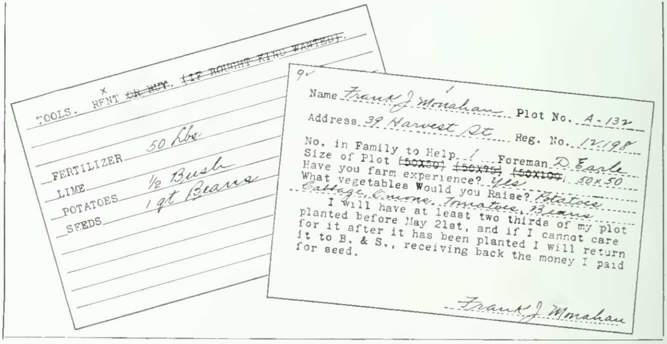
At one of the smaller gardens a tool shed was also provided. The group of 25 men cultivating this garden had a celebration and flag-raising. Figure 4 shows this garden later on, when the potatoes were in bloom.

The plan was carried out of having the main tool shed open from daylight in the morning until shortly before working hours each week day, again at noontime, from six o'clock in the afternoon until dark at night; also on Saturday afternoons and to some extent on Sundays. A charge of 50 cents was made for those who desired to hire tools and a large supply of ordinary garden implements and wheelbarrows was secured, so that men need not have the expense of purchasing a full set. This also was convenient for those coming from a distance, as all could obtain the tools on check and leave them when through their work without having to carry them back and forth, an especial advantage for those who used the street cars.



A CHANCE TO SERVE YOUR COUNTRY AND YOUR FAMILY
BY HELPING TO MEET THE
SERIOUS SHORTAGE IN THE FOOD SUPPLY.
CULTIVATE A GARDEN THIS SUMMER.
THE BROWN & SHARPE MFG. CO., WILL COOPERATE
BY FURNISHING LAND, PLOWING, AND FERTILIZER FREE FOR THOSE
WHO WILL RAISE CROPS FOR NEXT WINTER'S USE
PRIZES TO BE AWARDED WILL BE ANNOUNCED LATER
FOR LOCATIONS OF LAND SEE MAP HEREWITH
IF ENOUGH APPLY FROM OTHER SECTIONS OF THE CITY, AN EFFORT
WILL BE MADE TO SECURE LAND IN THOSE NEIGHBORHOODS
EXPERT INSTRUCTIONS WILL BE GIVEN FREE
MAKE APPLICATIONS THROUGH YOUR CLERK TO THE
INDUSTRIAL DEPARTMENT.
APR 16, 1917 BROWN & SHARPE MFG. CO.

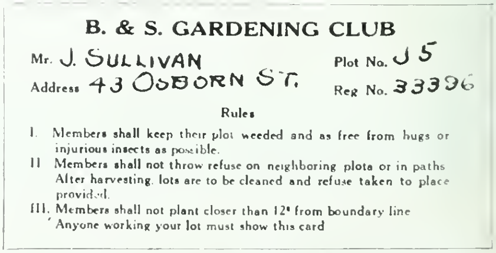
FIG. 1. NOTICE POSTED ON BULLETIN BOARDS



TOOLS. ×RENT ~~OR BUY.~~ ~~(IF BOUGHT KIND WANTED).~~
FERTILIZER 50 lbs
LIME
POTATOES ½ Bush
SEEDS 1 qt Beans

9✓
Name Frank J. Monahan Plot No. A-132
Address 39 Harvest St Reg. No. 12198
No. in Family to Help 1 Foreman D. Earle
Size of Plot ~~(50X50)~~ ~~(50X75)~~ ~~(50X100)~~ 50×50
Have you farm experience? Yes
What vegetables Would you Raise? Potatoes Cabbage, Onions, Tomatoes, Beans
I will have at least two thirds of my plot planted before May 21st, and if I cannot care for it after it has been planted I will return it to B. & S., receiving back the money I paid for seed.
Frank J. Monahan

FIG. 2. CARD ON WHICH APPLICATION FOR GARDEN WAS MADE. THE REQUISITION FOR TOOLS, FERTILIZER AND SEED WAS ENTERED ON BACK



B. & S. GARDENING CLUB

Mr. J. SULLIVAN Plot No. J 5
Address 43 OSBORN ST. Reg No. 33396

Rules

I. Members shall keep their plot weeded and as free from bugs or injurious insects as possible.
II. Members shall not throw refuse on neighboring plots or in paths. After harvesting, lots are to be cleaned and refuse taken to place provided.
III. Members shall not plant closer than 12" from boundary line.
Anyone working your lot must show this card

FIG. 3. OFFICIAL "BLUE CARD" NOTIFYING OF LOCATION OF GARDEN; PROOF OF A RIGHT TO BE ON THE GARDEN LOT WHEN CHALLENGED

In many cases gardens became family affairs, and all the members of the family took part, either in the work or in supervision. Figure 5 illustrates this feature.

As the season advanced a spirit of good fellowship, and the forming of new acquaintances among those who found themselves cultivating neighboring gardens, was one of the features which added to the value of the garden project. It was sometimes found that a laborer working side by side with a foreman could, from the gardeners' standpoint, turn the tables, become instructor and set the pace. When illness prevented some man from working and there were no members of his family to help out, shopmates often volunteered and cared for his garden or even harvested his crops for him.

FIG. 4. SATURDAY AFTERNOON AT ONE OF THE GARDENS. POTATOES IN BLOSSOM

FIG. 5. GARDENS OFTEN BECOME FAMILY AFFAIRS

Instruction and Inspection

To insure the success of the gardens even when cultivated by inexperienced gardeners, careful instructions were given, not only by the superintendent in charge but by notices sent to each gardener—(see Fig. 6). Often gardens cultivated by men having had experience adjoined those where the workers were amateurs. In such cases the best of good will was shown in giving and taking advice and instruction.

Inspections of the gardens were regularly made by the superintendent, and a book record kept with an entry for each garden. This showed the condition at the time of each inspection. Whenever a garden showed signs of being neglected a notice was sent to the workman. Not only was he stimulated into bringing his garden into good condition again, but the knowledge of the fact that such inspections were being made spurred many to even greater effort so as to keep their gardens in a condition above criticism.

Depredations

Many of the men took the gardening so seriously that questions, sometimes of a petty nature, were constantly coming up for consideration and at times small troubles were magnified. On the whole, however, the best of spirit was shown, even when there were losses from theft or from straying cattle.

Every effort was made to prevent depredations, guards being employed part of the time, and the coöperation of the police department and other officials also secured. In spite of all efforts there was some thieving, but it amounted to a surprisingly small percentage of the total value of the crops raised. This did not make it any easier, however, for the person losing his crops, perhaps several bushels of potatoes, or some fine squashes in which he was taking special pride.

Among the steps taken to avoid such losses was the creating through the public press of a sentiment emphasizing the special meanness of thieving from workmen who, from patriotic motives, went to the extra labor of raising produce under difficulties, in addition to doing their day's work in the shop. A mutual insurance plan against thieving was considered but was not put into effect because of the difficulty of proving losses.

Overcoming Troubles

Men came for advice regarding all sorts of troubles, watching with "eagle eye" over the condition of their gardens and bringing in samples of various kinds of bugs and diseased plants for advice. Lice among other pests attacked the potatoes for a time. The flourishing condition of the gardens as a whole, however, gave continued satisfaction to those having the success of the project at heart. This flourishing condition was illustrated by one man who came for advice very much worried because his cabbages were growing so fast that they cracked and he wanted to know "how to stop them from growing so fast."

Through a misunderstanding in the assignments two men were located on the same lot and each had fertilized and planted it to his own liking without knowing of the work of the other. A satisfactory adjustment was made by giving these men additional land but the double-planted garden developed interesting results in mixed crops. Had there been available the wizardry of a Burbank, there might have been produced some new and wonderful crosses in the vegetable line. As it was it produced crops of high value—for one reason because of its double fertilizing.

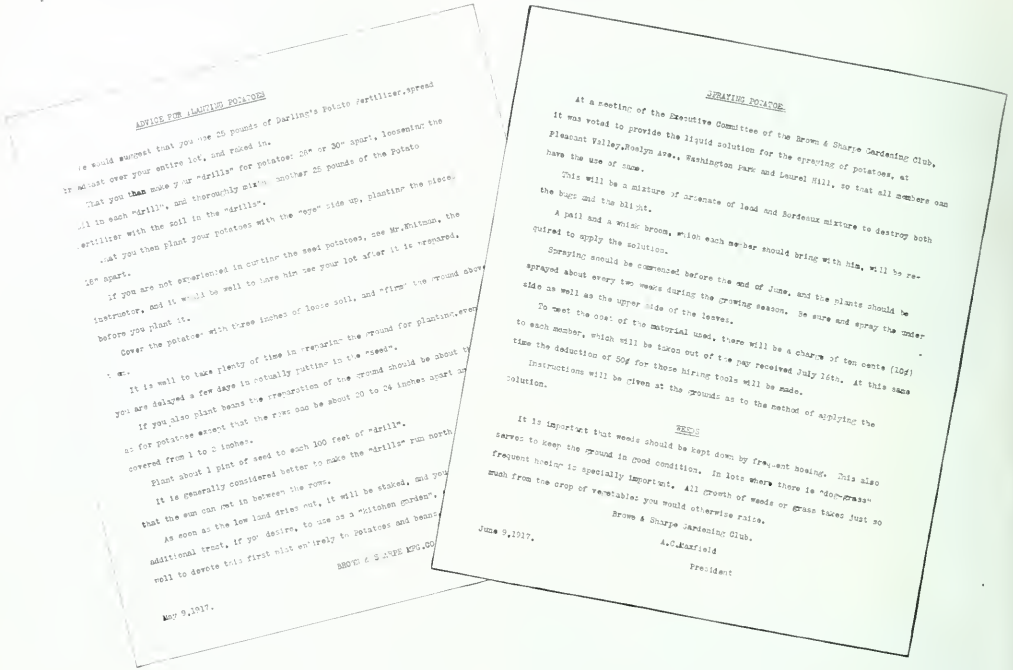
The fact that practically all of the gardens were well fertilized had much to do with their success, as compared with the amateur garden usually encountered.

Prize Contests

As the season progressed a friendly rivalry between the different plats as well as between individual gardens was encouraged.

Eighteen prizes were offered by the company for the best crops as to size and quality. An exhibit (see Figure 7) was held, and more than one hundred entries were made for the prizes; among these were 42 pecks of A1 potatoes. First, second and third prizes were awarded for the best pecks of potatoes, the largest produced, the best beans, best dozen of parsnips, carrots and turnips, and for the largest of each of these latter by weight. The prizes were offered for staple crops only, it will be noted.

Prizes were also offered by the Retail Merchants' Division of the Providence Chamber of Commerce for family and individual gardens in the community, and the Brown and Sharpe gardens came in for a liberal number of the awards in the classes in which they competed. A careful record of the produce of each garden, and its value, was kept, and tabulated for use in this latter competition. Refer to Figure 8.


ADVICE FOR PLANTING POTATOES

We would suggest that you use 25 pounds of Darling's Potato Fertilizer,spread
broadcast over your entire lot, and raked in.
That you then make your "drills" for potatoes 28" or 30" apart, loosening the
soil in each "drill", and thoroughly mixing another 25 pounds of the Potato
Fertilizer with the soil in the "drills".
That you then plant your potatoes with the "eye" side up, planting the pieces
18" apart.
If you are not experienced in cutting the seed potatoes, see Mr.Whitman, the
instructor, and it would be well to have him see your lot after it is prepared,
before you plant it.
Cover the potatoes with three inches of loose soil, and "firm" the ground above
them.
It is well to take plenty of time in preparing the ground for planting,even
you are delayed a few days in actually putting in the "seed".
If you also plant beans the preparation of the ground should be about th
as for potatoes except that the rows can be about 20 to 24 inches apart an
covered from 1 to 2 inches.
Plant about 1 pint of seed to each 100 feet of "drill".
It is generally considered better to make the "drills" run north
that the sun can get in between the rows.
As soon as the low land dries out, it will be staked, and you
additional tract, if you desire, to use as a "kitchen garden",
well to devote this first plot entirely to Potatoes and beans

BROWN & SHARPE MFG.CO

May 9,1917.

SPRAYING POTATOE.

At a meeting of the Executive Committee of the Brown & Sharpe Gardening Club, it was voted to provide the liquid solution for the spraying of potatoes, at Pleasant Valley,Roslyn Ave., Washington Park and Laurel Hill, so that all members can have the use of same.

This will be a mixture of arsenate of lead and Bordeaux mixture to destroy both the bugs and the blight.

A pail and a whisk broom, which each member should bring with him, will be required to apply the solution.

Spraying should be commenced before the end of June, and the plants should be sprayed about every two weeks during the growing season. Be sure and spray the under side as well as the upper side of the leaves.

To meet the cost of the material used, there will be a charge of ten cents (10¢) to each member, which will be taken out of the pay received July 16th. At this same time the deduction of 50¢ for those hiring tools will be made.

Instructions will be given at the grounds as to the method of applying the solution.

WEEDS

It is important that weeds should be kept down by frequent hoeing. This also serves to keep the ground in good condition. In lots where there is "dog-grass" frequent hoeing is specially important. All growth of weeds or grass takes just so much from the crop of vegetables you would otherwise raise.

Brown & Sharpe Gardening Club.

June 9,1917.

A.C.Maxfield

President

FIG. 6. SAMPLES OF NOTICES THAT WERE DISPLAYED GIVING INTRUCTIONS AND ADVICE TO AMATEUR GARDENERS

Just at Christmas time the awards were made, $216 in prizes coming to the company's gardeners. This sum included club prizes for each of the seven sections into which the gardens had been divided, one of these sections securing first prize. By vote of the officers, the club prizes, amounting to $130 were donated to the American Red Cross. A first prize was also received by a member of the Brown & Sharpe Gardening Club for the best individual garden. Accompanying each money prize was a certificate, shown in Figure 9, page 209, which the recipients always prize highly.

RECLAIMING WASTE LAND

The workman who won first prize not only had a successful garden where he raised potatoes and beans, but in addition he cultiviated a garden in some reclaimed swamp land that the company had secured on account of the shortage of other land to meet the gardening needs. The latter plot yielded an exceptionally good crop of carrots, parsnips, etc.; the two gardens together produced crops valued at $68.80. The use of this swamp land was an experiment and was interesting as showing large returns from what had previously been considered land absolutely worthless for garden purposes, and land which had never been previously cultiated. It was grown up to a solid mat of grass and weeds and was so wet that it could not be plowed. It was divided into small plots, however, and the men were offered an opportunity to go in and "grub it out." A number took advantage of this, trenching between the plots so that the water would flow off, and turning over the sod so that it was buried beneath the soil. Lime was used liberally on this land and it yielded excellent crops without manuring. It is hoped that even better results may be obtained from it during the coming season, because of its now having been worked into a friable condition, and because it will be available to use much earlier in the season than last year. The draining already done will help to dry it out earlier. The crops may then be matured and harvested without danger of an early frost which last year wrought serious

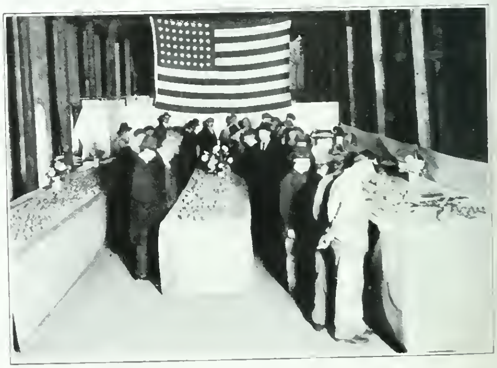


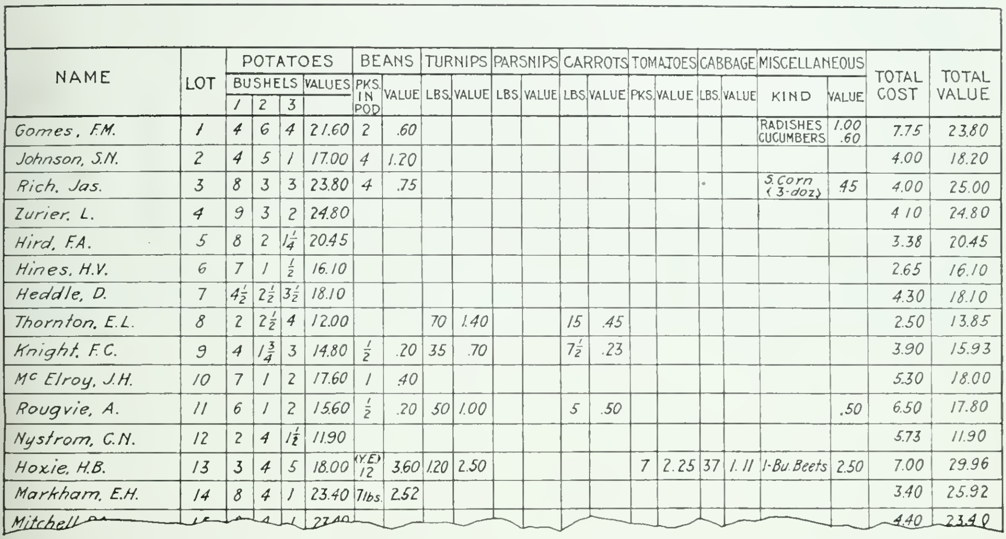
FIG. 7. GARDEN EXHIBIT HELD IN A SHED AT THE FACTORY AT THE CLOSE OF THE SEASON, IN COMPETITION FOR PRIZES

havoc in this particular garden, because of its swampy location and late planting that was necessary.

Extremes Meet As Prizewinners

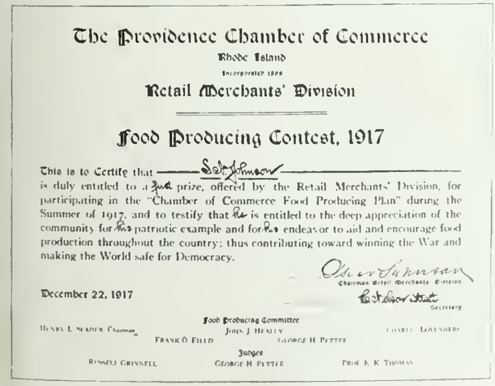
The second prize was taken by an amateur gardener, who, without previous experience, but with enthusiasm and industry coupled with a willingness and ability to learn, secured a crop valued at $47.60.

The opposite extreme was shown by another prizewinner, who was an experienced gardener and secured an exceptionally good crop even though putting the least work of any into his garden, because he knew just when to do the work and how to make it effective. He prepared the ground and cut and planted the "seed" potatoes during one Saturday afternoon, and at the end of the season harvested 15½ bushels of potatoes in a like time. He chose very hot days to hoe so that the weeds would be killed by the sun's heat, and the ground kept in condition with fewer hoeings than required by those who hoed on rainy or damp days. He chose his days for spraying so that it was done in dry weather, the solution drying on the leaves leaving the poison to do its work.



NAME	LOT	POTATOES				BEANS		TURNIPS		PARSNIPS		CARROTS		TOMATOES		CABBAGE		MISCELLANEOUS		TOTAL COST	TOTAL VALUE
		BUSHELS			VALUES	PKS. IN POD	VALUE	LBS.	VALUE	LBS.	VALUE	LBS.	VALUE	PKS.	VALUE	LBS.	VALUE	KIND	VALUE		
		1	2	3																	
Gomes, F.M.	1	4	6	4	21.60	2	.60											RADISHES CUCUMBERS	1.00 .60	7.75	23.80
Johnson, S.N.	2	4	5	1	17.00	4	1.20													4.00	18.20
Rich, Jas.	3	8	3	3	23.80	4	.75											S. Corn (3-doz)	45	4.00	25.00
Zurier, L.	4	9	3	2	24.80															4 10	24.80
Hird, F.A.	5	8	2	$1\frac{1}{4}$	20.45															3.38	20.45
Hines, H.V.	6	7	1	$\frac{1}{2}$	16.10															2.65	16.10
Heddle, D.	7	$4\frac{1}{2}$	$2\frac{1}{2}$	$3\frac{1}{2}$	18.10															4.30	18.10
Thornton, E.L.	8	2	$2\frac{1}{2}$	4	12.00			70	1.40			15	.45							2.50	13.85
Knight, F.C.	9	4	$1\frac{3}{4}$	3	14.80	$\frac{1}{2}$	.20	35	.70			$7\frac{1}{2}$	.23							3.90	15.93
Mc Elroy, J.H.	10	7	1	2	17.60	1	.40													5.30	18.00
Rougvie, A.	11	6	1	2	15.60	$\frac{1}{2}$	.20	50	1.00			5	.50						.50	6.50	17.80
Nystrom, C.N.	12	2	4	$1\frac{1}{2}$	11.90															5.73	11.90
Hoxie, H.B.	13	3	4	5	18.00	(Y.E.) 12	3.60	120	2.50					7	2.25	37	1.11	1-Bu. Beets	2.50	7.00	29.96
Markham, E.H.	14	8	4	1	23.40	7lbs.	2.52													3.40	25.92
Mitchell			4	1																4.40	23.40

FIG. 8. DETAILED RECORD OF YIELD AND VALUE OF PRODUCE OF EACH GARDEN ON WHICH AWARDS OF PRIZES WERE BASED



The Providence Chamber of Commerce
Rhode Island
Incorporated 1868
Retail Merchants' Division

Food Producing Contest, 1917

This is to Certify that S.N. Johnson is duly entitled to a 2nd prize, offered by the Retail Merchants' Division, for participating in the "Chamber of Commerce Food Producing Plan" during the Summer of 1917, and to testify that he is entitled to the deep appreciation of the community for his patriotic example and for his endeavor to aid and encourage food production throughout the country; thus contributing toward winning the War and making the World safe for Democracy.

Chairman Retail Merchants' Division

December 22, 1917

Secretary

Food Producing Committee
Henry L. Slader Chairman
John J. Healey
Charles Lovenberg
Frank O. Field
George H. Pettee

Judges
Russell Grinnell
George H. Pettee
Prof. E. K. Thomas

FIG. 9. AWARDS IN THE PATRIOTIC FOOD PRODUCING CONTEST IN PROVIDENCE

The largest crop of potatoes in a single garden (20 bushels) was raised on a lot which the gardener enlarged by digging up land which had been a dump beyond the plowing. The secret, however, of this large yield was that in addition to fertilizing well he buried all the sod beneath the drills where the potatoes were planted, giving the extra value of the rotting sod as food for the growing plants.

The largest yield of potatoes per acre of any of the gardens was 17 bushels (mostly No. 1 grade) on a garden of 2,000 square feet. This is at the rate of about 358 bushels to the acre.

A gratifying feature was the large yield after practical farmers, and others ready to give advice, had spoken discouragingly as to the fertility of some sections of the land and predicted that crops could not be raised on it especially by amateurs. At the beginning of the season an analysis of the soil of the more important tracts had been made by the County Agent of the Farm Bureau, and advice had been given the men as to what crops could best be produced on the different tracts, also as to where and to what extent lime was needed on the land. So far as the men followed the advice based on this information they were usually successful. Some, however, tried to raise peas, green corn and other summer crops on land not suitable, and the results were almost uniformly disappointing. This shows the importance of knowing beforehand what are the conditions and conforming to them.

Precautions for Factory Gardens

When the Brown & Sharpe garden project was first considered, it was urged that it should either not be undertaken at all or else be gone into in a comprehensive way, and not with the idea of "playing at" gardening as is so often done by amateurs. It is believed that unless an industrial organization is willing to undertake such a project seriously, provide the necessary personnel and funds, and enter into it in a way to insure plans being carried out, unsatisfactory results will follow.

Labor Factors in Our Shipping Program

How to Procure and Maintain Shipyard Workers and Hasten the Building of Our Emergency Fleet

By Roy Willmarth Kelly

A force of 250,000 men is to be enrolled to build our emergency fleet, of which some 1,500 vessels are under construction in 132 shipyards. The real obstacle to manning these yards is the excessive labor turnover. In a few cases a sufficient number of men have been secured, employment and service departments have been established, housing has been looked after and methods of training set up. All of these points are helpfully discussed in this article from the background of actual results.

Mr. Kelly *has had extensive experience in technical and industrial training, including the positions of acting principal of the Technical High School, Fall River, Massachusetts, vice principal Pacific Grove High School, Monterey County, California, and director of vocational guidance in the pre-vocationol schools of Boston, Massachusetts. He is now Director of the Bureau of Vocational Guidance of Harvard University. At the request of the Emergency Fleet Corporation, this Bureau has recently completed a book describing the leading shipbuilding trades and giving an account of the experience and general qualifications necessary for them with the object of recruiting a large body of workers and giving them all available information.*

REPORTS of two significant shipbuilders' conferences have been published by the Industrial Service Department of the Emergency Fleet Corporation. Both of these conferences devoted the major part of their attention to four problems: 1. Scamping, or the practice of taking men from other yards; 2. Locating and distributing the available supply of labor; 3. Employment and service departments in the ship yards and the preparation of personnel executives; 4. An industrial training program for workmen.

The results which have been attained following the recommendations of these two conferences are of far reaching importance, not alone to the shipbuilding industry, but to all employers. They are of permanent interest to any satisfactory solution of our labor difficulties and, for that reason, the efforts of the industrial branch of the Emergency Fleet Corporation to tide over the war crisis in the ship yards are of much more than temporary consequence.

We shall build good ships here,
At a profit if we can,
At a loss if we must,
But always good ships.

Collis Potter Huntington.

This inscription is on a stone tablet in the ship yard at Newport News. It is a splendid motto for Liberty shipbuilders.

Those who are familiar with the turnover figures from the steel mills, building trades, structural steel work, and other occupations similar to those found in ship yards, will appreciate the extent of the task faced by the shipbuilders. Chairman Edwin N. Hurley of the Shipping Board recently stated before the Senate Investigating Committee that a total of 1427 merchant vessels were under construction in 132 different ship yards. These yards and the fabricating plants supplying them are scattered over 25 states, from the Atlantic to the Pacific and from the Lakes to the Gulf. On January 1, 1917, seventy-four of these yards existed only in contracts and blueprints. Several are now employing from 10,000 to 12,000 men each. When completed, the Hog Island yard near Philadelphia will require over 35,000 employees. To point out that in the nine weeks beginning October 6, 1917, the number of men engaged in 109 yards was increased by 45.2 per cent. shows at once the magnitude of the recruiting program.

CAN ENOUGH MEN BE FOUND TO BUILD OUR SHIPS IN TIME?

The accomplishments of a few yards where the working force has been built up successfully with little or no Federal aid shows that there are plenty of capable men available. The Fore River plant of the Bethlehem Steel Corporation had 3,700 men on its pay rolls in May, 1917. On December 7, 1917, the total had been increased to 10,253. This was brought about almost wholly by machinery already in force which had not been used by other manufacturers. Among the means utilized were coöperation with Federal and State employment offices, the Y. M. C. A., and educational institutions, advertising at the state fairs, and developing an employment and welfare service and advertising it in a perfectly legitimate way.

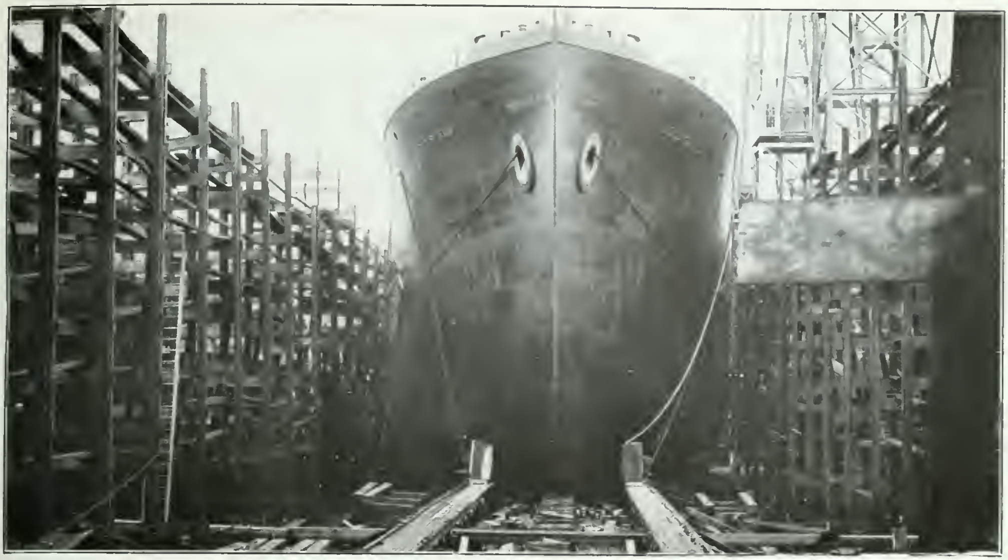
Mr. Morgan, who had charge of constructing the canonment at Ayer, Massachusetts, and who has had experience in building wooden ships, has this to say of the supply of carpenters and shipwrights:

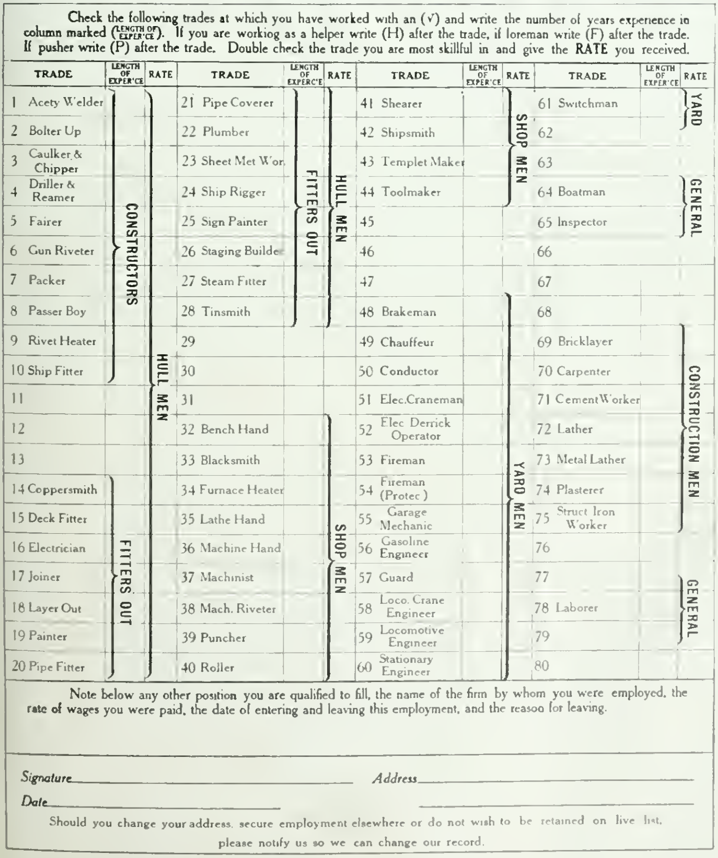
> "At the beginning of the war, I was delegated to cover New England and get a line on the men who were willing to take up government work. According to the statistics of our general secretary, there are about 35,000 competent ship carpenters registered from different parts of the country belonging to our union. . . . . There are 65,000 organized carpenters in New England."

It is only fair to suppose that many of the men referred to by Mr. Morgan could readily undertake shipyard work.

During the month of October, 1917, Federal employment bureaus placed 45,000 people in productive industries. In November of last year, Mr. C. T. Clayton, Chief of the Federal Employment Service, stated that 140,000 men were then listed who were willing to take up employment in different parts of the country.

With the present extended organization of Federal labor reserves and the excellent work being done by the National Chamber of Commerce and other organizations, there seems to be every reason to suppose that it will be possible to locate enough men who are willing





Check the following trades at which you have worked with an (√) and write the number of years experience in column marked (LENGTH OF EXPER'CE). If you are working as a helper write (H) after the trade, if foreman write (F) after the trade. If pusher write (P) after the trade. Double check the trade you are most skillful in and give the RATE you received.

TRADE	LENGTH OF EXPER'CE	RATE	TRADE	LENGTH OF EXPER'CE	RATE	TRADE	LENGTH OF EXPER'CE	RATE	TRADE	LENGTH OF EXPER'CE	RATE
1 Acety Welder	CONSTRUCTORS	HULL MEN	21 Pipe Coverer	FITTERS OUT	HULL MEN	41 Shearer		SHOP MEN	61 Switchman		YARD
2 Bolter Up			22 Plumber			42 Shipsmith			62		
3 Caulker & Chipper			23 Sheet Met Wor			43 Templet Maker			63		
4 Driller & Reamer			24 Ship Rigger			44 Toolmaker			64 Boatman		GENERAL
5 Fairer			25 Sign Painter			45			65 Inspector		
6 Gun Riveter			26 Staging Builder			46			66		
7 Packer			27 Steam Fitter			47			67		
8 Passer Boy			28 Tinsmith			48 Brakeman		YARD MEN	68		
9 Rivet Heater			29			49 Chauffeur			69 Bricklayer		CONSTRUCTION MEN
10 Ship Fitter			30			50 Conductor			70 Carpenter		
11			31			51 Elec.Craneman			71 CementWorker		
12			32 Bench Hand		SHOP MEN	52 Elec Derrick Operator			72 Lather		
13			33 Blacksmith			53 Fireman			73 Metal Lather		
14 Coppersmith	FITTERS OUT		34 Furnace Heater			54 Fireman (Protec)			74 Plasterer		
15 Deck Fitter			35 Lathe Hand			55 Garage Mechanic			75 Struct Iron Worker		
16 Electrician			36 Machine Hand			56 Gasoline Engineer			76		
17 Joiner			37 Machinist			57 Guard			77		GENERAL
18 Layer Out			38 Mach. Riveter			58 Loco. Crane Engineer			78 Laborer		
19 Painter			39 Puncher			59 Locomotive Engineer			79		
20 Pipe Fitter			40 Roller			60 Stationary Engineer			80		

Note below any other position you are qualified to fill, the name of the firm by whom you were employed, the rate of wages you were paid, the date of entering and leaving this employment, and the reason for leaving.

*Signature*____________________ *Address*____________________

*Date*____________________ ____________________

Should you change your address, secure employment elsewhere or do not wish to be retained on live list, please notify us so we can change our record.

COMBINED APPLICATION BLANK AND EMPLOYEES' RECORD CARD

to do the work of the yards. But this does not end the crisis. Many of the yards are now producing much less than their maximum output due to lack of labor. The situation has been complicated by cold winter weather and the coal shortage. It will become more acute as the new yards now being rushed to completion call for their full allotment of workmen.

LABOR TURNOVER: THE REAL OBSTACLE TO MANNING THE SHIP YARDS

At the Ship Yard Employment Managers' Conference in Washington last November, Admiral Capps made this significant statement: "In 64 yards of which we have recently had accurate data, the turnover averaged 235 per cent., and probably was 300 per cent. at the last report. You can well realize what this means in the volume of men passing through our works in the course of a year without any adequate return in labor." This proportion probably holds true in other establishments not reported.

Although these figures represent the turnover during the construction period and under bad weather conditions, there is ample rea-on to believe that large labor fluctuations are still going on.

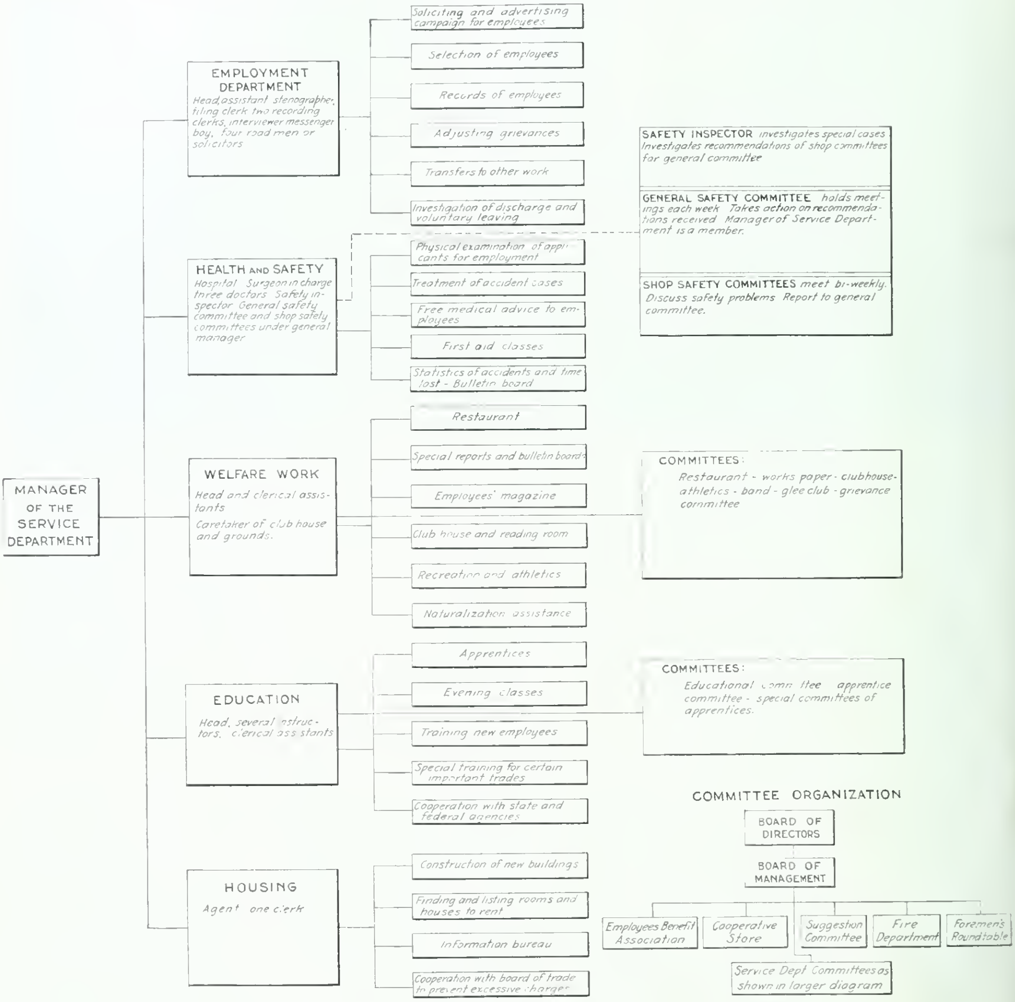

Soliciting and advertising campaign for employees
Selection of employees
Records of employees
Adjusting grievances
Transfers to other work
Investigation of discharge and voluntary leaving
EMPLOYMENT DEPARTMENT
Head, assistant stenographer, filing clerk two recording clerks, interviewer messenger boy, four road men or solicitors
SAFETY INSPECTOR investigates special cases Investigates recommendations of shop committees for general committee
GENERAL SAFETY COMMITTEE holds meetings each week Takes action on recommendations received Manager of Service Department is a member.
SHOP SAFETY COMMITTEES meet bi-weekly. Discuss safety problems Report to general committee.
Physical examination of applicants for employment
Treatment of accident cases
Free medical advice to employees
First aid classes
Statistics of accidents and time lost - Bulletin board
HEALTH AND SAFETY
Hospital Surgeon in charge three doctors Safety inspector General safety committee and shop safety committees under general manager
Restaurant
Special reports and bulletin boards
Employees' magazine
Club house and reading room
Recreation and athletics
Naturalization assistance
MANAGER OF THE SERVICE DEPARTMENT
WELFARE WORK
Head and clerical assistants
Caretaker of club house and grounds.
COMMITTEES:
Restaurant - works paper - clubhouse - athletics - band - glee club - grievance committee
Apprentices
Evening classes
Training new employees
Special training for certain important trades
Cooperation with state and federal agencies
EDUCATION
Head, several instructors, clerical assistants
COMMITTEES:
Educational committee apprentice committee - special committees of apprentices.
COMMITTEE ORGANIZATION
BOARD OF DIRECTORS
BOARD OF MANAGEMENT
Construction of new buildings
Finding and listing rooms and houses to rent
Information bureau
Cooperation with board of trade to prevent excessive charges
HOUSING
Agent one clerk
Employees Benefit Association
Cooperative Store
Suggestion Committee
Fire Department
Foremen's Round table
Service Dept Committees as shown in larger diagram

DIAGRAM SHOWING WORK DONE IN DEVELOPING PERSONNEL MANAGEMENT

Accepting the conservative estimate of 500,000 men needed in the ship yards, the total number to be hired every year if this turnover persists will far exceed the number that can be spared even temporarily from other necessary occupations.

Some light is thrown on this situation by Table I. The figures there given were compiled from a yard where conditions were exceptionally good. They represent a turnover much less than could be expected to obtain after the yard had trebled in size. It is important to note that the bulk of the men whose term of service is less than one year are in the very large departments of the steel mill and outside hull construction. Several of the shops make an equally disturbing showing.

It should be remembered that this table is only suggestive of the amount of the turnover, since it gives a view of the situation on a given date and does not take account of fluctuations during the year.

Expressing the term of service from such a table as an average does not properly describe employment conditions. To say that the average term of service is 2.6 years, balances a few long term employees against a large number who have been in the organization only a few weeks. The median (the point above and below which there are an equal number of employees when they are arranged in order according to length of service) falls in this case within the one-year group. It is much nearer the truth, therefore, to state that in this plant the median term of service was less than one year, probably only 10 or 11 months.

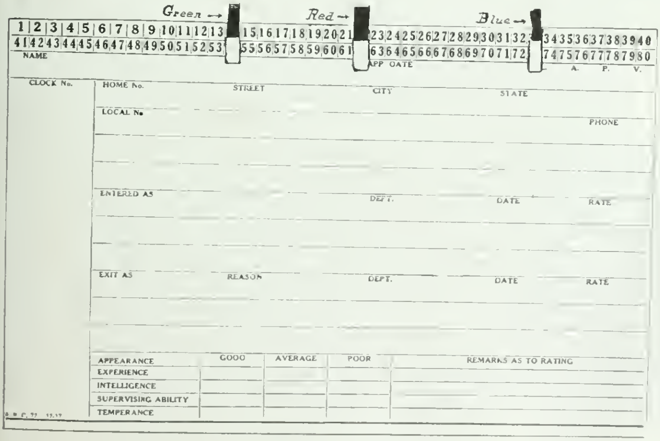
If these conditions obtained only in the ship yards, the matter would be of comparatively slight consequence. But such is decidedly not the case. Employers everywhere, and especially large manufacturers, face exactly the same situation.

SOME PRELIMINARY MEASURES

To reduce the wasteful migration of labor, "scamping" has been prevented in the Navy Yards by an executive order. This prohibits the engagement of any man who has been working for a concern on government contracts within three months of the time of his application without a written release from that firm. An agreement has been entered into by the yards under the Shipping Board by which a similar release must be given in the form of clearance papers from the local Federal or State employment bureau in the district where the man was last engaged.

TABLE 1
TERM OF SERVICE OF EMPLOYEES IN A SHIP YARD—NOVEMBER 23, 1916
Average Term of Service—2.6 Years; Median Term is Less than 1 Year

Department	Under 1 Year	1 Year	2 Years	3 Years	4 Years	5 to 10 Years	Over 10 Years	Total No. Employed	% Under 1 Year	% 1 Year or Less	% Over 10 Years
Executives and Office Force	48	31	20	16	5	30	39	189	25.4	41.8	20.6
Drafting	37	25	9	11	10	21	6	119	31.1	52.0	5.0
Totals	85	56	29	27	15	51	45	308	27.6	45.7	14.6
Blacksmiths	15	15	8	5	2	11	8	64	23.4	46.9	12.5
Pipe Shop	79	87	28	36	13	11	1	255	31.0	65.0	0.4
Electrical Department	20	20	11	18	9	9	7	94	21.3	21.3	11.7
Power House	8	3	5	2	2	3	1	24	33.3	45.8	4.1
Foundry	**38**	**9**	**10**	**6**	**3**	**3**	**0**	**69**	**55.1**	**68.0**	**0.0**
Shipwright	**45**	**10**	**8**	**7**	**6**	**18**	**9**	**103**	**43.6**	**53.4**	**8.7**
Pattern Shop	**21**	**8**	**4**	**2**	**3**	**4**	**6**	**48**	**43.7**	**60.4**	**12.5**
Joiner Shop	**38**	**14**	**14**	**6**	**2**	**14**	**1**	**89**	**42.7**	**58.4**	**1.1**
Sheet Metal	9	39	16	10	9	13	1	97	9.3	49.5	1.0
Machine Shop	63	109	66	15	26	80	34	393	16.0	43.8	8.6
Paint Shop	**49**	**14**	**6**	**2**	**1**	**17**	**0**	**89**	**55.1**	**70.9**	**0.0**
Outside Machinists	26	42	18	16	17	19	6	144	18.1	47.2	4.1
Riggers	23	12	15	5	5	11	9	80	28.7	43.7	1.1
Outside Hull	**501**	**133**	**50**	**44**	**28**	**43**	**13**	**812**	**61.7**	**78.0**	**1.6**
Storage and Warehouses	**20**	**13**	**1**	**3**	**3**	**6**	**1**	**47**	**42.5**	**70.3**	**2.1**
Boiler Shop	**29**	**10**	**2**	**8**	**4**	**9**	**4**	**66**	**43.9**	**59.1**	**6.0**
Steel Mill	353	86	36	26	27	37	8	573	61.6	71.6	1.4
Yard Maintenance	**57**	**26**	**13**	**5**	**5**	**12**	**7**	**125**	**45.6**	**66.4**	**5.6**
Yard Totals	1394	650	309	216	165	320	116	3170	40.1	64.6	3.6
Totals	1479	706	338	243	180	371	161	3478	42.5	62.8	4.6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LOCAL No.
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DATE
RATE
APPEARANCE
GOOD
AVERAGE
POOR
REMARKS AS TO RATING
EXPERIENCE
INTELLIGENCE
SUPERVISING ABILITY
TEMPERANCE

FIG. 3. EMPLOYEE'S RECORD FOLDER
The original is a 5 x 8 folder of heavy manilla paper

Some very effective work has been done by the Chamber of Commerce of the United States. Not the least valuable part of its contribution has been the creation of increased enthusiasm for the shipbuilding program. By posters, badges worn by those engaged in shipbuilding, and a widespread publicity campaign, the Chamber has done a great deal toward making the men in the yards appreciate the light in which their tasks ought to be regarded by the people at large.

SHIP YARD EMPLOYMENT AND SERVICE DEPARTMENTS

With the advice and assistance of the Industrial Service Department of the Emergency Fleet Corporation, much has been done during the past few months to improve employment conditions in the yards. Regular reports are being received in Washington which show the extent of the flow of shipbuilding labor, and the special needs of each plant are being carefully considered. Professor Carroll W. Doten has been called from the Department of Economics of the Massachusetts Institute of Technology to assist in supervising the collection and interpretation of statistics. Numerous conferences have been held with representatives of the yards who are dealing with the question of labor supply, and suggestions and assistance are constantly being given to managers and superintendents who are striving to find and train men and keep them steadily at work.

The measures so far taken are quite certain to fail of their intended objective unless every plant is brought to see the need for systematic study of its own problems of labor maintenance. Relatively few of the yards have any organization by which such a study can be carried on. For many years shipbuilding was not a highly profitable industry and on that account relatively little progress has been possible in some of the newer forms of management. In many cases, hiring and discharge are still in the hands of foremen who are already greatly overtaxed by the constant pressure for increased production.

The Union Iron Works at San Francisco, The Submarine Boat Corporation of Newark, and The Newport News Shipbuilding and Dry Dock Co., are among the yards that are active in developing personnel management. A diagram showing the work done by one of the Bethlehem concerns is given on page 212.

THE MOLD LOFT IN A LARGE MODERN YARD BUILDING STEEL SHIPS

Lines for every part of the hull are laid out on this floor to full size scale. Wooden templates are then made from which the structural steel is marked by the ship fitters

Some Suggestions from the Submarine Boat Corporation

Men applying for work in a particular trade at the Submarine Boat Corporation are given that work if possible. If there is no available opening, they are given a job of a similar nature, or any work for which they are adapted.

Thus many good men are secured and held in employment until they can be rightly placed, and meanwhile the yard has them on hand for an emergency. Aside from the general laborers, skilled men only are employed. The combined application blank and employee's record card in use in this plant is shown in the illustration on page 211.

Transfers are effected by means of the folder of Figure 3, page 213. The red tag indicates workers hired for trades from 1 to 40, and is placed in the first line space on the folder. The blue tag placed on the second line, is for workers hired for trades numbered from 41 to 80. A green tag placed on numbers from 1 to 40, on the first line space of the folder, shows the trade the workman is skilled in. Similarly, yellow tags placed on the second line show trades from 41 to 80 in which the workman has had experience.

A REAMER AT WORK

Ninety per cent. of riveting, drilling, reaming, and calking is done with pneumatic tools

When an additional worker or workers are wanted in any part of the plant, a demand is made upon the employment department, which first consults the employment records in the folders. Before taking on new men, transfers are made of those who can be spared from the departments in which they are working, or who properly belong in the work for which the call comes.

This all saves time in securing new men and expedites work in the yard. It also creates a good feeling toward the company on the part of the worker because it means placing a man finally where he is best fitted to be.

Full provision is made for housing by a careful study of all available houses, boarding-places and rooms. Applicants for positions are kept over night if necessary, or they are taken care of at once. Arrangements are being made for housing at more distant points, outside of Newark, as the number of workers increases. Special trains are to be run into New York night and morning to carry employees.

In many of the other yards not so fortunately located housing has become one of the most pressing problems. Barracks and cottages are being built by several of the shipbuilding concerns and plans are under way for extensive housing provisions at government expense.

Training Employment Managers

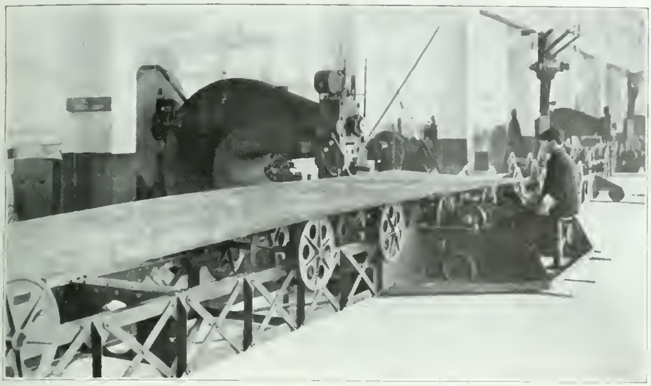
One of the serious drawbacks to putting the best employment practice into effect is the lack of trained employment managers.

Large concerns everywhere are awake to the need and are seeking men with the right ability and preparation to take charge of newly organized employment and service departments.

Colleges and technical schools ought to appreciate the presence of this urgent demand and plan to offer the right kind of intensive training for workers in this field. Here is clearly one of the places where service of the most valuable kind can be rendered.

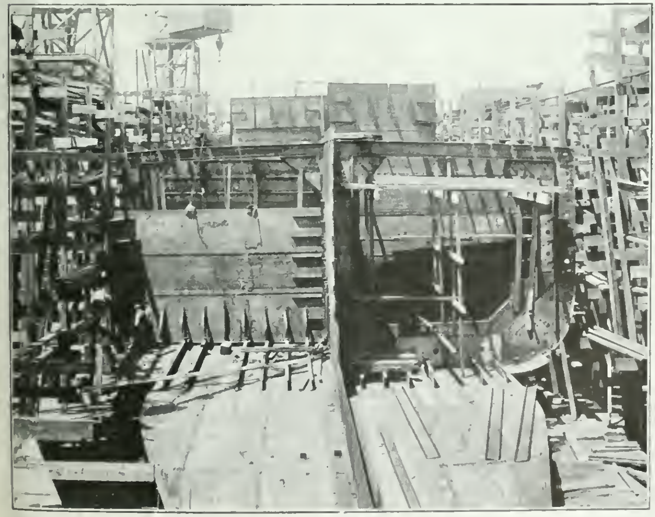
The Kind of Workmen Needed in the Ship Yards

At the request of the Emergency Fleet Corporation, the Bureau of Vocational Guidance of Harvard University recently prepared a brief description of the leading shipbuilding trades. The purpose of this publication is to give in simple form an account of the work done in each department and of the experience and general qualifications men ought to have who apply for positions.


AN AUTOMATIC PUNCHING MACHINE IN THE STEEL SHOP
This machine punches rivet holes in the plates, or "strakes," for the hull of the ship

Little or nothing of interest to the lay reader has been published regarding the operations involved in shipbuilding, or of the conditions confronted by those who engage in it. Through this study, material is now made available which will assist men in deciding for themselves the probability of their proving successful in these trades.

In the course of the Bureau's investigations, some interesting changes now in progress of development in the methods used by shipbuilders were brought to our notice. One of these relates to practices in the mold loft. Here full size templates of wood or paper are made for laying out the steel plates and frames used in ship construction. It was formerly supposed that only men of many years' experience could be used for laying out the lines on the floor from which the templates are made. The special difficulty lies in the presence of curved surfaces, but all classes of mold loft work do not present these problems. Several progressive yards have discovered that it is entirely practicable to apportion the work in such a way that the lines and templates for all flat work, such as bulkheads and certain parts of the hull, can be handled by carpenters, structural steel men, or sheet metal workers.


A STANDARD OIL TANKER UNDER CONSTRUCTION
Under ordinary conditions, it took 6 months to get the ship to this stage. In 1917 the Union Iron Works completed the 10,000 ton steel ship Paulsboro in 119 working days

Young high school and trade school graduates are being trained as shipfitters on classes of work that were previously given to highly trained men. Thus in several branches of the industry, subdivision and analysis of tasks have made it possible to put men at work after a few weeks of intensive training on what were formerly regarded as highly skilled operations, requiring long experience.

Where Workmen Are Most Needed

It is impossible to make any general statement that will apply throughout the United States as to the shipyard trades for which men are most in demand. Since there is an insufficient supply of experienced shipyard workmen, men from similar outside trades must be taken over and trained as quickly as possible. In the publication above referred to, the Bureau of Vocational Guidance has listed over 80 industrial fields outside of shipbuilding, from which men can be called who will have had a useful background of experience.

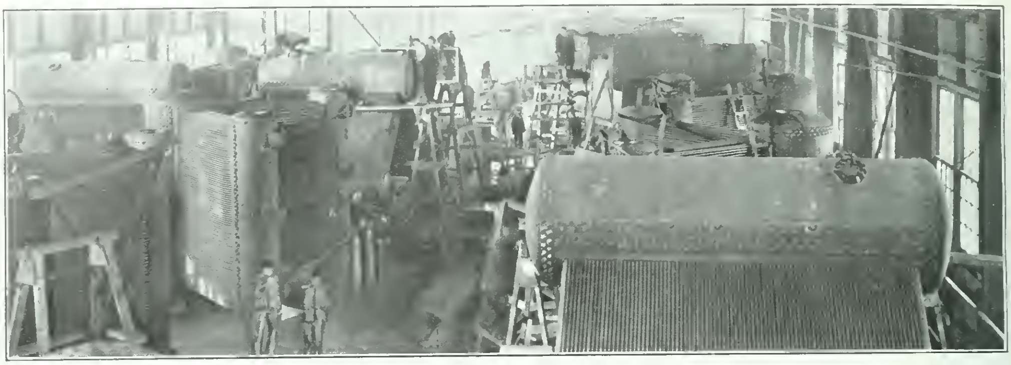
The table of the distribution of employees, Table 2, gives some idea of the extent and variety of the occupations involved. Hull construction, the steel mills, machine shops, boiler shops, foundries, and yard maintenance are among the departments in the yards most likely to be short of men.

The new yards will obviously need a full quota of men for every department. Taking men to become leaders in these yards, has depleted the supply of skilled men in the older plants and made it necessary for them to enter upon a campaign of training.

Distribution of Employees

Table 2 gives a distribution of the workmen in the leading departments, exclusive of the office force, in five typical yards building steel ships. Although these figures do not cover enough yards to prove anything conclusively, nevertheless, they raise an interesting question.

It will be noted that wide variations appear among these yards in the number of employees engaged in a given department, as compared with the total number on the payroll. In some cases these deviations can be explained on the basis of differences in the character of the work being done. Nevertheless, it seems likely from the statements of employment managers and from a general analysis of the situation, that at no time within the last year have the larger yards been able to so regulate the number of men in each of their departments as to reach a maximum efficiency in production. A thorough examination of similar statistics from all the yards ought to be made to furnish the basis for a more careful regulation of the proportionate number of workmen to be placed in each division. Extended study of this problem in each yard ought to result in much better coördination of effort in addition to a considerable saving in labor.



A TYPICAL BOILER SHOP OF A LARGE SHIP YARD
The yards are building 78-ton Scotch boilers as well as water-tube boilers of the Yarrow and White-Forster types

Training Workmen for the Ship Yards

At Newport News a training center for shipyard instructors has been established. All the yards engaged on work under the Shipping Board are invited to send experienced men to the school whom they wish to have trained as instructors. After four to six weeks of intensive training in practical pedagogy, these men return to their own plants and take up the work of breaking in new employees.

Many of the methods of instruction in use are based upon the experience of the Navy Yards extending over a period of years. Additional plans and courses are being developed which can later be utilized in establishing similar schools elsewhere.

The employment department of the Harlan and Hollingsworth plant has drawn up a plan by which 30 men are to be brought from Cornell University to undertake training in the yard during the spring of 1918. These men are in the senior class of the engineering courses. Because of the great variety of experiences to be derived from the numerous shops and the many classes

TABLE 2
NUMBERS AND PER CENT OF EMPLOYEES IN THE LEADING TRADES OF FIVE TYPICAL STEEL SHIP YARDS

Department	Yard No. 1		Yard No. 2		Yard No. 3		Yard No. 4		Yard No. 5		Total Average	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Anglesmiths	23	0.5	37	0.8	27	1.1	25	6	*		112	0.6
Blacksmith Shop	103	2.3	54	1.1	63	2.7	40	.9	64	2.1	324	1.7
Boiler Shop	135	3.0	70	1.4	116	4.9	128	2.9	65	2.2	514	2.7
Erectors and Bolters-up	615	13.7	400	8.1	*		*	...	*		1015	10.8
Calkers and Chippers	217	4.8	196	4.0	91	3.9	255	5.8	*		759	4.7
Copper Shop	18	0.4	39	0.8	61	2.6	80	1.8	*		198	1.2
Drillers and Reamers	264	5.9	441	9.0	550	23.4	450	10.1	*		1685	10.4
Electrical Shop	154	3.4	142	2.9	41	1.7	125	2.8	94	3.1	556	2.9
Fitters	149	3.3	215	4.3	128	5.4	210	4.7	*		702	4.3
Foundry	*		60	1.2	*		51	1.3	69	2.3	180	1.5
Galvanizing	27	0.6	*		*		7	0.2	80		34	0.4
Joiner Shop	105	2.3	32	0.6	47	2.0	157	3.5	89	3.0	430	2.5
Machine Shop	479	10.7	983	20.0	176	7.5	563	12.7	593	13.2	2494	13.0
Mold Loft	88	1.9	46	0.9	24	1.0	45	1.0	*		203	1.3
Naval Architecture	*		86	1.7	*		46	1.1	119	4.0	251	1.9
Outside Machinists	141	3.1	250	5.0	33	1.4	*	...	144	4.8	568	3.9
Paint Shop	179	4.0	124	2.5	45	1.9	198	4.5	89	3.0	635	3.3
Pattern Shop	51	1.1	62	1.3	20	9	42	1.0	48	1.6	223	1.2
Pipe Shop and Plumbing	221	4.9	206	4.2	47	2.0	256	5.8	285	8.5	983	5.1
Riggers	115	2.5	121	2.5	20	0.9	296	6.7	80	2.7	632	3.3
Riveters	551	12.3	564	11.4	324	13.8	490	11.1			1929	11.9
Sheet Metal Shop	82	1.8	170	3.4	38	1.6	60	1.4	97	3.3	447	2.3
Shipwrights	194	4.3	277	5.6	50	2.1	298	6.7	103	3.5	922	4.8
Steel Mill	292	6.5	*		203	8.6	252	5.7	573	19.2	1320	9.3
Yard and Ship Laborers	280	6.3	330	6.7	205	8.6	253	5.8	125	4.2	1193	6.2
Oxy-acetylene	*		15	0.3	19	9	12	0.3	*		46	0.4
Total Number of Workers in these Departments in the Yard	4483		4930		2358		4439		2981		19191	

*No satisfactory data supplied.

of work represented by a ship yard, it is felt that students in such courses can obtain an excellent opportunity for practical experience.

Two divisions will be made of the students. Those who are primarily interested in mechanical engineering will go into the engineering department. They will become accustomed in the course of a few months to the assembling and erection of machinery, boiler testing, trial trips, and other experience that would probably take three or four years to obtain in the ordinary way. Those who are interested in structural steel work, or in drafting, will go into the drafting room, or into the mold loft. Some of them will be taken on as ship fitters.

In the evenings special lectures by college professors and practical men in the shipbuilding industry will be given for each group. These lectures will also be open to foremen, leading men, and others in the yard who are capable of profiting by them. They will be so planned as to follow up the work done by the students during the day.

It is hoped that the Harlan and Hollingsworth plan will prove to be another practical means of training leaders and instructors that can be adapted to the needs of other yards.

Holding Men in the Industry

The interest already manifested and the aggressive methods adopted by the Emergency Fleet Corporation, by the Labor Department, and by individual yards show that a large supply of labor can be recruited and trained in a short time. It is questionable whether an equal amount of attention has been given to keeping men steadily at work. The outstanding factors in this part of the program may be summarized as follows:

The initial selection of men must be so regulated as to accord fair and courteous treatment to all who apply. In no other way can men be encouraged to volunteer for shipyard service.

Transfers and promotions must be effected quickly and equitably. This implies better office methods than are now in use in the majority of our large industrial plants.

The crisis demands, and men have a right to expect, that steady employment will be provided. A large shipyard may be spread over several hundred acres and includes 18 to 20 shops and mills, numerous storehouses, docks, power plants, and an extensive transportation system—all necessary to the central work of erecting ships on the ways. Only by carefully coördinating these activities, can layoffs and delays be prevented. Training gangs of men who can be shifted into any one of several different kinds of work is one means of reducing lay-offs or temporary idleness due to weather conditions or operating emergencies.

Local transportation systems must be improved so that men will not be unnecessarily delayed in going to and from their work. One morning recently at a New England yard, nearly a quarter of the total force were from five to twenty minutes late because of poor street car service. Nearly 500 men returned to their homes rather than suffer the customary fine of an hour's pay. A serious transportation problem has confronted this yard for months and an equally unfortunate situation exists in many other shipbuilding centers.

The severe exertion of the work requires that men must be well fed and housed if they are to be kept in good health. Many of the yards have no suitable restaurants in or near the plant where a nourishing lunch can be procured at noon.

Medical and physical examinations should be used as a basis for the selection of employees, and a well equipped dispensary and hospital are indispensable to the welfare of the men. Hundreds of men can be saved to the industry every month by attention to this one factor.

Participation in management through a committee organization such as that suggested by the diagram on page 212, creates a better spirit among the men and helps executives to locate trouble before discontent spreads too far.

We are agreed that our army cannot be effective unless high standards of morality are maintained. So long as our shipbuilding committees tolerate vice and drunkenness, we cannot expect to create either a stable or an efficient working force.

Much of the appeal in securing workmen for the yards has been patriotic in its nature. This is properly the case. It ought to be understood by every man who performs any task in a shipyard, great or small, that he is engaged in work that is of supreme national importance. Only by coöperative effort and willingness to endure a few temporary hardships can we build our victory fleet and build it quickly.

The Price of Safety Against Fire

By Charles Hill

When in charge of a plant using quantities of nitro cellulose, I found that the fire danger was reduced to the lowest degree by the following: 1. Fire extinguishing appliances; 2. Care of stock; 3. storage of supplies; 4. care of waste; 5. cleanliness; 6. inspection.

1. FIRE EXTINGUISHING APPLIANCES. The overhead sprinkler system, installed when the building was built, was kept in good order by the careful examination of the fire heads every three months. They would keep an ordinary fire within a 13-foot circle, and summon help from the city fire department and ring the watchman's fire gong. Fire buckets with water or sand, as required, were provided one for each man.

Over the manager's desk was placed the tell-tale box of an electric fire signal system, where by a glance he could see where help was needed. Over each large sink was a coil of one inch hose.

Ten of the reversible type fire extinguishers (the carbonate of soda and sulphuric acid type of from two to three gallons capacity) were in place; also ten extinquishers of the carbon-tetrchloride type (useful for electrical fires) were over the manager's and foreman's desks. This was the fire-fighting apparatus.

2. CARE OF STOCK. The celluloid stock was received three times a week and placed in a fire-proof vault with a heavy vault door. Here the product was also kept when completed before shipment. The vault was ventilated by a six-inch inlet pipe at the floor, and a six-inch outlet to the outside of the building.

The electric wiring was in iron conduit pipes with switches outside the vault. The electric lights had extra covers of thick glass and wire guards placed high.

3. STORAGE OF SUPPLIES. The supplies were in a fire-proof room with chemicals and all inflammable liquids in safety cans.

4. CARE OF WASTE. At the end of each bench was a fire-proof can to hold cuttings with an inner perforated disk to hold the waste down under water. This disk was attached to the lid by a short chain. All waste was removed from building at 4 p. m. each day.

All delicate machines were covered each evening with covers of rubber cloth to protect against dust from sweeping and water from bursting overhead sprinkler.

5. CLEANLINESS. Cleanliness was the rule. The workmen fell in line, as the place was clean and kept clean.

6. INSPECTION. At 8:30 a. m. there was a thorough inspection of side door exits, windows and fire buckets. The manager personally made the rounds.

Radiators were partly covered with loose iron covers to prevent the contact of material and were inspected daily. No rubbish was allowed to accumulate behind the radiators. Fire-proof doors and iron clothes closets were provided. The windows were self-closing.

Each motor was covered with a loose iron cover keeping pieces of stock from contact with the motor. The electric lights over the benches had the usual cone-shaped reflectors. These were covered with wire gauze to prevent material coming in contact with a broken electric globe in case of accident.

Absolutely no smoking was the rule *and the rule was in force.* No matches of any sort could be carried into the building and anyone found with matches was discharged. On hiring new employees it was understood that the manager and assistant would be likely to inspect the clothing in the lockers at uncertain intervals by feeling for matches. Fire must have a cause, so remove the cause.

Difficulties in Employing Women

By L. H. Colburn

General Manager, Colburn Machine Tool Company

THE writer has read your editorial in the January number of INDUSTRIAL MANAGEMENT and it certainly hits the nail on the head. The question of employing women is a most timely one, and one that should be kept before the public until it is settled so that the nation will get the benefit of the work of the vast army of women that are available, but for certain reasons are not used to the extent they should be.

In the writer's opinion, based on recent experience, the principal difficulty in employing women is the attitude of the labor unions. To illustrate: The Colburn Machine Tool Company has a large and splendidly equipped plant located in a small city where the living conditions are of the best. There is plenty of sunshine, good air, beautiful surroundings such as trees, grass and flower beds, in fact everything to make working conditions pleasant. We work eight hours a day, pay time-and-one-half for overtime and double-time for Sunday work.

We pay the highest wages to machinists and other labor, but in spite of this we have been greatly handicapped on account of not being able to get sufficient help. We are now and have been "full up" for about three years with important war business.

We exhausted all our efforts to get additional men; we advertised in the newspapers for hundreds of miles around; we sent employment agents to the large cities; we offered our workmen bonuses for getting additional men—but all to little purpose. Finally, last July we decided to start to employ women in some of the departments of our plant. We had never employed women in the shop before, but made a careful investigation first and went around to plants in other cities where they were employing women successfully and got ideas on the subject.

We decided that we could use about 50 women on our work, putting them on small machines, light bench work, fitting, etc. We made inquiries and found that we could get all the women we wanted, in fact, they welcomed the idea because, for one thing, we resolved from the start that we would pay them just as much as we paid men for the same work.

We made no secret of the fact that we intended to employ women. Rather, we gave the matter all the publicity we could, thinking that this would let it be generally known that we wanted a lot of women. We had many applications and actually engaged a number. Meantime we went ahead and fitted up special quarters for them consisting of dressing, toilet and rest rooms.

OBJECTIONS FROM THE MEN

About that time we commenced to hear rumors of objections on the part of our men employees belonging to the machinists' union, and finally we were notified that a committee representing them wanted to see us. We received the committee and found that they were unalterably opposed to our employing women in the shop in any capacity. They were afraid that the women if once admitted would, after the war, keep the places which they claimed rightfully belonged to men. No amount of arguing would change them in their stand.

We had a strike about two years ago in regard to the eight-hour day, and we finally granted it on a compromise, whereby we gave the eight-hour day and nine-hours pay, but we did not grant a lot of other demands made at the same time. We run an open shop, but about two-thirds of our machinists probably belong to the union. They have given no trouble since the strike, in fact we have not had a committee wait on us for a year and a half until this question of women employees came up.

Rather than have any trouble we gave up the idea of employing women for the present. We put about seven or eight in the tool room and stock room to wait on the window, look after the stock and do various jobs not in these two departments. They do not run any machines except hack saws. This is as far as we have been able to get in employing women in our establishment, notwithstanding the fact that we could still use 50 of them, if the machinists' union did not object.

OBJECTIONS OF THE PUBLIC

Aside from the objection on the part of the union, we have found that the general public also objects to some extent. Of course, we would not care about this if the union did not object, as we felt that this prejudice would be overcome after the women actually worked a while. However, as it seems impossible to change conditions at present we thought we would start a little educational campaign to mold gradually the sentiment around here in favor of employing women. One of our local papers just put out a special number and wanted us to take space. We decided to take a page. It was a sort of an argument in favor of women working in the manufacturing industries. The illustrations showed some of the largest heavy-duty drill presses built by us being operated by women in manufacture of large shells.

Although these machines are made by us in our plant in Franklin, and are operated by our customers with women employees, we are not allowed to run them except by men. It has been demonstrated many times that women can run such machines as well as the men. It does seem to be a most inconsistent thing, that we are not allowed to operate these machines in our shop, when our customers in many other places are doing so?

If our legislators at Washington were not afraid of the consequences they would take steps to remedy some of these wrongs and not only do justice to all women and men alike, but thereby overcome one of the greatest obstacles in winning the war and that quickly.

The Employees' Benefit Association—III

What Service Shall It Render? What Benefits Shall It Pay?

By W. L. Chandler

This installment discusses the questions of what kind of medical, hospital and nursing service should be provided, and then turns to the specific problems of benefits for various forms of disability and deaths of members and dependents. The problems presented and answered are from Number 30 to 47, inclusive.

Mr. W. L. Chandler *has had experience in every department of the plant of The Dodge Manufacturing Company. Of late years he has specialized on the study of employees' relations. He has been identified with many local and national movements, was chairman of the Danger Emblem Committee of the National Safety Council, and is now chairman of a committee of the National Association of Purchasing Agents.*

WHAT should a benefit association do for its membership? We have considered various problems pertaining to its organization and management in the two preceding issues of INDUSTRIAL MANAGEMENT. Now we must decide what service shall be rendered to the members, what limits shall be placed upon the benefits, and later on must determine the amounts of daily benefits and the rates of dues required to permit such benefits safely.

PROBLEM NUMBER 30

SHOULD AN ASSOCIATION PROVIDE FREE MEDICAL SERVICE?

This is one of the problems most open to debate, and is receiving a great amount of attention everywhere. It is being approached from both the angle of the association and also from that of the self-interest of employers in maintaining their forces at the highest point of efficiency. Difficulties are met in making satisfactory arrangements with physicians for this service.

Of the associations reporting to the Commissioner of Labor, 20 per cent. and 30 per cent. of those reporting direct to me, maintain free medical service, but detailed costs and plans of operation are not ready for tabulation.

In many cases the function of the association physician appears to be not to render complete medical service, but more to guard against imposition. In some associations, he supplies only first aid treatment in case of accidental injuries. In others he acts through free consultation, but gives no medicine.

Frequent discussions of this subject discloses a general feeling that free medical service for association members, for all employees in fact, is quite desirable. Many feel that such services for wives and dependents of members would be highly beneficial in the direction of eliminating one of the greatest causes through which members or employees, get into the hand of the loan sharks, leading to an harrassed mind, domestic trouble and consequent inefficiency.

The present great doubt relates to the question of management. A difficulty due to malingering, whereby both the physician and member may benefit unjustly, is a big factor to be overcome. Some physicians have been paid a yearly salary of a stated amount per member, but the service has been criticised as indifferent.

With so many experimenting with this question, we shall soon have more definite information for consideration. Medical service of the association need have no relation to any medical supervision of employees on the part of the employer. However, combining these functions offers certain advantages.

Workmen's compensation laws have increased the interest of employers in the selection of the right man for the right place, and in guarding against the placing of men subject to apoplexy, etc., in charge of equipment where they may injure themselves or others, etc.

Labor distrusts the plans for medical supervision on general principles. I suggest, as an educational feature, that the medical inspection of employees be handled through the association physician, the employer contributing toward the expense of the physician to compensate for examinations of new employees, etc., provided the association accomplishes some specified thing as a condition of the employer's help. In this way, the men will be in closer contact with the work of the physician and therefore will see its advantages. (See Dr. Steinmetz's remarks in Problem Number 3, page 35 of the January number.)

The fact that the association physician is largely under the control of members will lead them to realize the benefits which they derive from medical consultations as a preventive of disease. The problem is to guard against any act which would give an opportunity for a disturbed mind to draw the conclusion that the information given to the doctor might be used disadvantageously in some manner, sooner or later.

If men can be brought to see the value to them of medical supervision, they will crave it instead of fearing it as they often do now. Physicians need not make free visits to the homes of members, but free consultations during certain hours at the plant have produced favorable results.

PROBLEM NUMBER 31

SHOULD AN ASSOCIATION PROVIDE A DENTIST?

A few associations now have arrangements whereby the teeth of members are examined frequently and kept in repair constantly. In view of the relation of the teeth to the entire physical system, it would seem wise to consider this point carefully, and if satisfactory arrangements can be made with local dentists, the men can be taught to appreciate the value of such service.

The examination of teeth and instructions for proper home treatment and care will prove a good step in the right direction. In such a plan the members would be referred to a dentist when treatment was needed.

The association dentist would probably secure much of this extra work on his own account if he proved to be popular with the members. In selecting a dentist great care should be exercised to pick a man who will become popular. It is through such popularity that an employer may expect to develop sentiment favorable to his plant and himself.

PROBLEM NUMBER 32

SHOULD AN ASSOCIATION PROVIDE AN OCULIST?

The eyes play a part fully as important as the teeth and often are the cause of many other ailments. Poor eyesight no doubt is the cause of frequent accidents endangering the lives of employees.

In view of the advantages arising from having a force of employees of known soundness of body, establishments may well consider the matter of absorbing the entire cost of the free medical, dental and ocular inspections and service as far as it is maintained.

This plan is already in successful operation in a few concerns and covers all employees. In most cases, the practitioners are on duty at the plant only at certain specified times. In many associations, the physicians do not visit the homes, but prescribe for those simpler cases which come to them while they are at the plant.

Problem Number 33

Should an Association Provide a Nurse?

A few establishments have nurses on duty at the plant only, while in other cases the nurses visit the homes, giving advice as to sanitation and allied subjects. This is not a common arrangement, however.

Some consider the services of a nurse as of value as a compromise between no medical service and full medical treatment. It is possible to spend a lot of money on a nurse with small return, just as on a physician or oculist, unless business methods are followed.

Nurses are of two types: One operates with mathematical precision, follows all rules and regulations laid down in the most formidably rigid hospitals, and while she may not provoke any actual ill-feeling of employees toward the establishment, she does not build up any of the good will so essential to the greatest success. The other has a big heart, and through her treatment of the sick and injured may build up relations between the employees and the establishment which will prove of great value when contrary influences develop from other sources from time to time.

Problem Number 34

Should an Association Provide Hospital Treatment?

A few establishments maintain private hospitals, while others have arrangements with nearby public institutions. In these cases, the service seems to be independent of membership in the association, and apparently the associations do not provide for hospital service except as it may be paid for by the beneficiary.

Some employers maintain beds at nearby hospitals for the free use of their employees when in the opinion of the plant physician the employee should have hospital treatment.

Problem Number 35

Should an Association Provide Benefits for Temporary Sickness Disability?

This benefit feature is provided for in 93 per cent. of the associations. Those which do not embrace this benefit are organized to provide death benefits only, except one for permanent disability and superannuation only, and two for superannuation only.

The reports did not distinguish between cases due to accidents and to sickness, but of all associations, comprising about 350,000 members, certain data has been compiled as is shown in Table 2.

Workmen's compensation does not cover disability or death due to sickness and does not cover accident when off duty, so the association may well cover these whenever the compensation act does not. Unquestionably all disability should be covered by some means, and in cases where compensation enters, the by-laws may provide special treatment as covered in Problem Number 36.

Table 2

Average Temporary Disability of 429 Associations and the Employees' Benefit Association of the Dodge Manufacturing Co.

	Experience for one year of 429 associations comprising 350,000 members. Covers both sickness and accidents.	Experience of association at Dodge Manufacturing Co. for 1915		
		Sickness and Accidents combined	Sickness only	Accidents only
Average cost per member for one year for disability benefits.	$3.42	$3.33	$2.74	$ .59
Percentage of all members receiving disability benefits in one year	21%	29%	24%	5%
Average amount of disability per beneficiary	19.12	11.58	11.42	12.41
Average length of disability per beneficiary	22.2 days	11.2 days	11.0 days	12.2 days
Average length of disability per member	4.7 days	3.31 days	2.64 days	0.58 days

Problem Number 36

Should an Association Provide Benefits for Temporary Accident Disability?

Regardless of workmen's compensation or employers' liability laws, 90 per cent. of all associations pay disability benefits for accidents, much as any accident insurance company would pay its just claims. Of these associations, 22 per cent. are managed at least in part by the establishments.

Some establishments have been reimbursing the associations for disbursements due to accidents to members while on duty in lieu of payments to the injured. The workmen's compensation laws interfere with such arrangements in most states. Some associations do not pay for any accidents for which the establishments are liable under the law.

Of the associations managed by employees alone, 93 per cent. pay these benefits; a very few restrict them to certain definite accidents such as those occurring when on duty, when going to or from work, or in some cases to accidents occurring when not on duty.

Of the associations managed either by establishments alone, or jointly by employees and establishments, 91 per cent. pay temporary disability benefits for accidents.

From the standpoint of temporary disability, workmen's compensation affords no protection against accidents except during work hours in regular occupations which, in some few industries, may be safer than those spent in going to and from work. Only about one-third of the actual hours in a year are covered by compensation. It is said that only about 50 per cent. of accidents disable for two weeks or more, so that in states where two weeks waiting time is required, compensation of itself does not take the place of employees' benefit protection where such benefits begin in less than two weeks.

When compensation awards, say fifty or sixty per cent. of a man's wages for disability due to work accidents, the association may well pay the balance provided the combined income does not exceed, say ninety per cent. of wages.

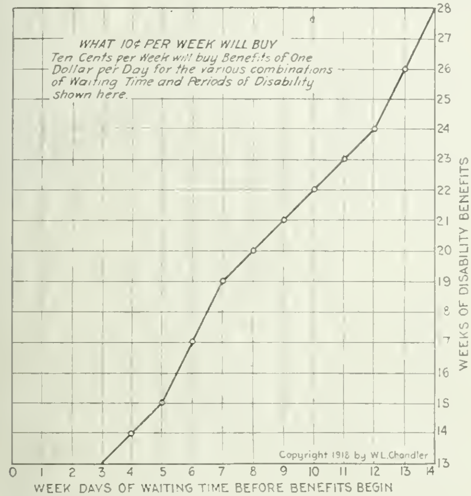
In this way, benefits received due to the employer paying compensation serve to reduce the cost to the association and help to create reserves and permit dividends, which will later be shown to be productive of much good.

In the experience for 1915, of the association at the Dodge Manufacturing Co., only about 18 per cent. of the benefits paid went for accidents of all kinds, and of this amount 83 per cent. was paid for work accidents, which formed 81 per cent. of all accidents experienced by members of that association.

Problem Number 37

Should an Association Provide for More Than One Period of Disability?

Of all the associations, 71 per cent. pay temporary disability benefits for sickness or accident during a single specified period varying from 5 to 52 weeks for one disability, or, in many cases, for the total of all disability benefits as a maximum in any year, 13 weeks being the general period.



On the other hand, 23 per cent. of the associations have a secondary period after the expiration of the first one, wherein the benefits are reduced. Adding both periods together, 26 weeks is much the most general total term for these.

The remaining 6 per cent. have three and four periods, some running apparently without constitutional limits.

Of the associations with three or more periods, one-third have no constitutional limits for the last period so long as membership is maintained.

The average disability of all associations for one year was 22.2 days, so that the cases of temporary disability extending beyond 13 weeks, which is the most popular first period limit, are very much in the minority; however, the Dodge experience indicates that cases running over 13 weeks are likely to be cases of permanent disability.

As a selling point, the fact of having a secondary period is a good one, and for the few unfortunates who are afflicted for a long time and consequently are very greatly in need of funds, the secondary period is a tremendous benefit.

The 1915 experience of the Dodge Association showed that their cost that year would have been two cents per week greater for each member if they had paid one dollar per day disability benefit for 26 instead of 13 weeks. Adding 50 per cent. to this for safety, as was done in all other rates, would have increased the dues for disability 30 per cent. or three cents per week, in order to have doubled the period of possible benefits. When we consider that the man who is disabled beyond thirteen weeks is tremendously less fortunate than his more favored brothers, we can appreciate the value of having protection to fall back on for a period as long as can be arranged.

Problem Number 38

Should an Association Provide Benefits for Permanent Disability Due to Sickness?

Only four per cent. of the associations pay benefits of this kind. This showing may possibly be increased by some associations where the by-laws are so written that some unusual case might be decided in favor of a member permanently laid up by some occupational disease, or where loss of an eye is covered and by-laws do not specify that it must be lost by accident. These are very remote possibilities, however, and probably four per cent. is about right. The reports do not distinguish between accidents and sickness, so all figures are combined and given under Problems 36, 39 and 49.

No figures are available at this time, but it appears that of disability due to sickness, permanent disability is of much less frequency than temporary disability, and the experience of the Dodge Association for one year shows that to have extended the period of disability benefits for both sickness and accident to cover six months instead of three would have increased the dues required for temporary disability 30 per cent.

A careful investigation of the cases of disability of the Dodge Association arising in 1915 indicates that any case running more than 13 weeks may well be considered as permanent disability. One member had lumbago and returned to work two days after benefits ceased. He *might* have been sick yet if benefits had continued. Others either died or were still disabled when last heard from. Some cases of tuberculosis, or other diseases, may throw a slightly different light on the matter, but for safety we should look upon cases running over 13 weeks as being permanent, until we can secure more accurate data.

Insurance covering permanent disability is extremely desirable from humane and sociological standpoints.

Problem Number 39

Should an Association Provide Benefits for Permanent Disability Due to Accident?

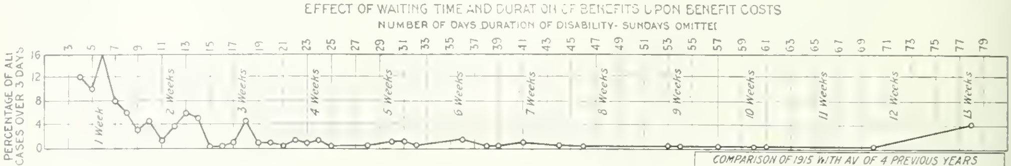
Twelve per cent. of the associations provide benefits of this nature. A quarter of one per cent. of the membership of these associations received such benefits in a year. The figures given include benefits covering sickness, as well as accidents in four per cent. of the associations, or one-third of those with this provision. The average cost per member for permanent disability for both sickness and accidents was 48 cents, and the average benefit for the year was $104.76 per beneficiary. This is equivalent to $48.60 for 13 weeks or 2½ times the amount per beneficiary for temporary disability.

Disability covering accidents beyond the protection of compensation should, in my opinion, be covered by insurance as soon as rates can be established. Can you imagine a sadder case than that of a man once well and a good provider, laid low by accident or disease so that his loved ones are in actual want while he realizes that if he were only dead rather than disabled, his family would be provided for through life insurance? What a strong temptation toward suicide.

Problem Number 40

Should an Association Provide Benefits for the Death of Members Due to Sickness?

A provision of this kind is found in 83 per cent. of the associations. In the statistical reports, no distinction is made between sickness and accidents, so the figures include both. These benefits vary from $10 to $2,000. The average death claim paid in one year is $209.76. For the year reported, the average cost per member of such associations for these death benefits was $1.45.



NOTE:- A waiting time of two weeks as often found in workmens compensation laws would eliminate 65% of the cases of over three days duration as charted

DURATION OF DISABILITY by percentage of cases experienced by the DODGE MUTUAL RELIEF ASSOCIATION in the year 1915

Benefits began after 3 days and ceased not to exceed 13 weeks. Sundays omitted Nearly all cases which ran over 13 weeks were permanent disability cases

COMPARISON OF 1915 WITH AV OF 4 PREVIOUS YEARS

LENGTH OF DISABILITY	PERCENTAGE OF ALL CASES	
	4 YR AV	1915
4 Days to 1 Week	41	46
Over 1 - less than 2 Weeks	24	24
" 2 - " " 3 "	12	9
" 3 - " " 4 "	7	5
4 Days to 4 Weeks	84	84

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Chart No 12

The death rate per 1,000 members was 6.7, being lower than the general death rate of the country, due to the fact that only able bodied persons can gain or retain employment in the industries. This fact contributed toward the differences between death benefits in these associations and straight life insurance.

The mobility of employees, together with their usual improvidence, makes it difficult to provide a form of benefit to remain available after a member has ceased to be employed in the establishment to which the association is attached, except as it may some day be done through a Federation of Benefit Associations.

Of the classes of industries, each represented by 10,000 or more members, the death rates per 1,000 are as follows

Iron and steel rolling mills	6.7
Machinery manufacturers	6.5
Coal mining	5.6
Street railways	8.8
Wholesale and retail stores	5.5

Unquestionably some amount of death or burial benefit should be provided, because it can be handled without much additional overhead cost and may be had for 2.5 cents per week for each member (for a benefit of $100 at death) with a fair margin of safety in the rate.

Comparison with the cost of industrial insurance shows this cost to be very favorable, not as a substitute, but as an additional source of benefit.

Problem Number 41

Should an Association Provide Benefits for Death of Members Due to Accident?

Data given under Problem Number 40 must be considered here also, as the associations in their reports did not distinguish between deaths due to sickness and those due to accidents. Ninety per cent. of all associations provide death benefits for accidents. Ten per cent. of these apply them only to accidents when on duty. Eighty-three per cent. pay for both sickness and accident.

Death benefits are usually for no more than burial purposes and amount to so little that no distinction should be made between deaths due to sickness and accident, and workmen's compensation awards may well be ignored in awarding death benefits. Deaths due to accidents are apparently much less frequent than those due to sickness.

Burial or death benefits should be paid regardless of whether death was the result of sickness or accident. There is no reason why a man should leave his family any more money because his death resulted from one cause than another. Policies of accident insurance which pay double benefits for certain accidents, which are necessarily infrequent to permit such payments, take advantage of the human inclination to gamble. There should be more of mutuality in an association.

Proplem Number 42

Should an Association Provide Benefits for the Death of Members' Wives?

Twenty-two per cent. of all associations have such a provision. Their annual cost for this service averaged about 25 cents per member. All members paid the same dues. This experience covers 65,889 members, of which 3.7 out of each thousand received such benefits in a year, the average benefit being $63.19.

Local conditions may affect the answer to this question. Labor now pays very high rates for industrial insurance, due to the necessarily high cost of doing such insurance business as it must be done under present plans. The cost of sending a collector to the home each week to collect small premiums is excessive in comparison with a plan whereby the amounts are paid to the association through the payroll along with the sickness and death premium covering the member himself.

It has been estimated that 26,000,000 persons in the United States carry industrial insurance, paying $120,000,000 per year, the average policy being $127. The average premium is about nine cents per week, indicating the reason for the high cost of collection.

It is also interesting to note that the number of persons carrying industrial insurance in the United States was 78 per cent. greater than in Great Britain, but the aggregate amount of insurance premium was practically no greater, indicating in this country either lower rates or smaller policies, or both.

Apparently five cents per week is a safe rate for a $100 benefit for death of wife, provided a reasonable number of the members insure their wives. In fact, I believe this rate can be lowered as soon as some experience is gained to point the way.

The insurance of wife and other dependents can be handled through the association more cheaply than through stock companies, and this has a tendency to attract men to the organization. In some cases, it may help reduce the frequency of the turn-over of men.

Problem Number 43

Should an Association Provide Benefits for Death or Disability of All Dependents of Members?

Ten per cent. of all the associations pay benefits for the deaths of dependents of members. The average cost for this service, covering other than wives, was about 28 cents for each member of these associations (44,381 persons), of whom six in each thousand received such benefits in a year, the average benefit being $43.46. These benefits range from about $10 for a stillborn child to $25 for the death of an 18-year-old child, $50 for father, mother, brother or sister, and in one case $100 for the death of a daughter in charge of the household of a member who had no wife (or husband).

Apparently no association has covered either temporary or permanent disability of either wives or other dependents. The matter seems like quite a long step now, but if the associations are looked upon as the easiest means of enabling labor to provide against future adversity along the lines of sickness and accident, I believe we shall, in a few years, see this feature embodied under suitable regulation in many of the associations.

As a step in this direction, it seems possible to cover with ample safety, deaths of dependent children over two and under sixteen years of age at the rate of four cents per week for a $50 benefit. The rates may be reduced as experience warrants. This rate is intended for those cases where only the members insuring children pay the dues for such coverage.

The average cost of 28 cents per year given in this problem covers cases where all members pay the same dues. This indicates that two cents per week *for all members* would permit an association to pay safely, say, about, $100 at the death of any dependent (wife, child, mother, etc.), of any member until enough experience was had to determine more scientific rates.

There is considerable question, however, about the willingness of labor to accept this sort of a plan where all members pay the same dues regardless of whether they have dependents or not. That can be best determined by a vote in each case.

Extract from By-Laws of Dodge Manufacturing Company Association

> Art. VIII. Sec. 4. Members of this association may each take the various benefits at the corresponding rates of dues, provided that no member shall receive from all sources temporary disability benefits in excess of ninety per cent. of his average wages for the three months preceding disability.

This permits each member to insure his dependents or not, as he chooses. The rates are made high enough to distribute the cost over the members who subscribe for the protection. See Problem Number 17 in the February issue, page 110.

Problem Number 44

Should Temporary Disability Benefits Be Computed by the Day, Week or Month?

Six per cent. of the associations pay by the day; 87 per cent. by the week; one per cent by the month; the remaining six per cent. did not specify. A few do not pay for a fraction of a week. It would appear to make little difference whether payments are computed by day or week, provided fractions of a week or month are prorated, otherwise the question is important.

Regardless of the frequency of the payment of benefits, the unit of measurement should be one day in order to treat all members fairly, and benefits should be paid with the same frequency as the wages of the establishment. Labor is generally accustomed to wages based upon daily rates; consequently, daily benefits paid weekly or less often are usually desirable.

Problem Number 45

How Soon After Joining Should a Member Be Eligible for Disability Benefits?

Of the associations paying temporary disability benefits, 42 per cent. provide that members are eligible as soon as they join the association. It is interesting to see that this provision is found in 88 per cent. of the associations managed by establishments, in 54 per cent. of those managed jointly; and in only 35 per cent. of those managed by employees. Fifty-eight per cent. of the associations require a specified length of membership ranging from one week to 12 months.

Thirty-eight per cent. of the associations having a specified time require membership of either 30 days, 4 weeks or one month; 26 per cent. require either 90 days, 12 weeks or 3 months; 11 per cent. require either 60 days, 8 weeks or 2 months; 10 per cent. require 6 months, while the remaining 15 per cent. are thinly scattered. A few pay at once in case of accident.

The purpose of requiring a period between joining the association and drawing benefits is to prevent employees from joining to draw benefits for a disability due to sickness, which they feel coming on them or to which they have been exposed. A medical inspection and an investigation before acceptance in connection with a period of 30 days' wait, during which new members are not eligible for benefits except for accidents, should prevent loss from disability resulting from diseases contracted before joining.

Problem Number 46

When Should Temporary Disability Benefits Begin?

Of all associations 93 per cent. pay temporary disability benefits. Twelve per cent. of these associatons begin payments from the date of disability without restriction. Thirty-one per cent. pay from the start for disabilities continuing for periods varying from more than two days to more than two weeks. Ten per cent. pay after a waiting period of from one to six days. Thirty-two per cent. do not pay for the first seven days. Four associations require more than seven days, two of them not paying for the first two weeks. Ten per cent. pay from the start of accident disability, a few specifying that it must be an accident while on duty, and they have periods varying from one to fourteen days before payments begin for sickness.

This question of temporary disability benefits has aroused considerable discussion in connection with workmen's compensation laws. The usual purpose of an association is to help the members when they cannot help themselves. If they can help themselves through disability of short duration, say the first three days, the cost of maintaining the association will be vastly less and dues will be correspondingly lower than when benefits cover the first three days. See Chart, page 222.

Several short periods of disability coming close together might be as unfortunate for the member and the association as one of longer duration and consequently should be covered by a provision whereby the total disability in a fixed period of time is taken into account when computing benefits. Extract from By-Laws Dodge Manufacturing Company Association, Art. VIII

> Sec. 19. Any conscientious efforts on the part of disabled members to return to work, which may actually result in relapse, causing two or more short periods of disability instead of one longer one, shall not deprive them of the benefits they would have received, had they remained away from work. They

shall not, however, be paid benefits for the days on which they work.

Sec. 20. Convalescent members able to work part time, may receive partial benefits in keeping with the facts at the discretion of the directors.

The law recently enacted by Congress covering compensation for employees of the United States Government in cases of accident and occupational diseases includes a provision for three days waiting time. This law has the support of the American Association for Labor Legislation and undoubtedly represents the views of our foremost socioligists. Similar laws in Switzerland and Germany have three days, while England has one week and our former United States law had 15 days.

The Dodge Association has always paid benefits beginning with the fourth day, so that no statistics pertaining to claims for disability for a shorter waiting time are available.

One very bad practice is found occassionally: An association may provide that benefits begin, say, after the first three days, unless the disability extends beyond a specified time, say one or two weeks, when payment is then made for the whole time. This is equivalent to saying that if a member who is disabled for a period approximating the specified amount of time will only stay home a few days longer, the association will not only pay benefits for the extra time off, but will give him a bonus consisting of the benefits covered by the waiting time. For example: a waiting time of four days may be cited; a member sick two days gets nothing, but if he will malinger two days he will receive benefits for all four days. No further comment is necessary.

PROBLEM NUMBER 47

SHOULD AN ASSOCIATION LIMIT THE PERIOD OR AMOUNT OF BENEFITS FOR TEMPORARY DISABILITY?

Four per cent. of the associations have no provision in their by-laws to limit the length of time during which a member may receive benefits for temporary disability. Some of these provide for a specified length of time as a maximum for each year, but apparently pay such benefits each year as long as disability continues.

Associations are of three classes: Those limiting the number of weekly benefits in one year; those limiting the benefits to a certain number of weeks for each disability regardless of how many disabilities there may be in a year; and those which limit the amount of benefits both for one disability and for one year. As shown previously, some have as many as four periods for one disability, each succeeding period carrying a smaller benefit than the one before it until the last one sometimes is very small.

Ten per cent. of the associations provide for donations from the treasury to disabled members, or extensions of periods according to the merits of extreme cases. The Dodge Association puts all incomes from merchandise sales, etc., into an emergency fund and loans this out without interest in some cases.

Table 3 shows the various periods and the number of associations in which each method prevails.

With 13 weeks as the most popular period and 22 days as the average disability, the cost of periods longer than 13 weeks is less than their relative lenghts would suggest.

The experience of the Dodge Association during 1915, together with what is known of experience elsewhere, indicates that for three cents additional dues each week, they could pay $1 per day benefits for 26 weeks instead of 13. It is interesting to note that the cost of this extra 13 weeks is the same as the difference in cost of the 10 days between three and 13 days waiting time. See Chart.

TABLE 3. RELATIVE POPULARITY OF THE VARIOUS LIMITS OF TIME DURING WHICH ASSOCIATIONS PAY DISABILITY BENEFITS

Associations having only one period of benefits

Limit in weeks for one year.	Number of associations in which limits prevail	Per cent. of total of this group	Limit in weeks for one disability	Number of associations in which limits prevail	Per cent. of total of this group
5	3		6	2	
6	9		8	10	
7	1		10	5	
8	10	4	12	6	
9	1		13	20	40
10	36		14	2	
12	38		15	2	
13	65	65	16	3	
14	2		17	4	
15	12		20	1	
16	5		25	1	
17	6		26	14	16
18	4		28	1	
20	5		39	1	
24	3		52	16	11
25	1				
26	27	11			
33⅓	1				
35	1				
59	1				
Unlimited	6				
Total	237			88	

Associations having two periods. Total of both combined

Limit in weeks for one year.	Number of associations in which limits prevail	Per cent. of total of this group	Limit in weeks for one disability	Number of associations in which limits prevail	Per cent. of total of this group
7	1		10	1	
9	2		12	1	
10	3		13	4	35
11	1		17	1	
12	2	20	24	1	
13	7		26	3	
14	1		30	1	
15	2		35	1	
16	1		36	1	
17	1		52	2	12
19	1		60	1	
20	4				
24	3				
25	1				
26	31	39			
30	2				
32	1				
35	3				
41	1				
52	8	15			
Unlimited	4				
Total	80			17	

Associations having three or more periods. Total of all combined

Limit in weeks for one year.	Number of associations in which limits prevail	Per cent. of total of this group	Limit in weeks for one disability	Number of associations in which limits prevail	Per cent. of total of this group
10	2		52	1	
13	2	20	104	2	
21	1				
26	2	10			
27	1				
36	1				
48	1				
52	3	14			
Unlimited	7	33⅓			
3 yrs.	1				
Total	21			3	

Before selecting the length of period, careful consideration should be given to all phases of this problem.

Under New Management—Judging Men

We Need Skilled Mechanics Somewhat, But We Need Foremen and Bosses Who Understand Mechanics Much More

By Charles M. Horton

The degree of success in installing efficiency methods depends upon the judgment used in handling labor—upon the understanding of the labor mind. And proper, intelligent, sympathetic care of the labor mind is hard to get among foremen and minor executives.

Mr. Charles M. Horton, *member of the American Society of Mechanical Engineers, was educated in the public schools of New York City and at the University of New Mexico. He served a drafting-room apprenticeship and has had twelve years' experience in designing special machinery. During a part of that period he was in the employ of the Westinghouse Machine Company, and was personal designer to Mr. George Westinghouse in the gas-engine division. As an avocation he has pursued literary work for years, writing for both fiction and technical publications.*

A MAN who does one job well will do all jobs well. Of course, the jobs themselves must be of a kind, in that they call for certain fixed capabilities. But even so. A neat toolmaker, for instance, will do a neat job of typewriting, once he gets his hand in. He is that kind of workman—if so be he *is* that kind of workman. Having commonsense, and the trick that goes with it, of reasoning from cause to effect, he will cut to the obvious in his work as surely as he will have his working tools always where he can instantly lay his hands upon them. A man of methodical mind, I believe such a man is called.

At any rate, such a man in an industrial plant is more to be chosen than great riches, because such a man is sharply representative of that which is synonymous with great riches in an industrial plant—efficient production. Nor will such a man ever give trouble. He knows what he knows, and takes a great pride in it; and because his work gives him the opportunity to exercise that which he knows, he will take a great pride in his work and will hold to it quietly and gladly.

Ralph Waldo Emerson said that every institution is but the lengthened shadow of a single man. Good judges of men are scarce—that is generally accepted. A good judge of men will surround himself with other good judges of men and his institution will enjoy a maximum of labor efficiency and a minimum of labor difficulties. Find a concern that is always having labor troubles and you will find a concern that needs reorganizing at the top.

Foremen with Judgment

The world of industry is ever on the watch for such men. Industrial heads will inform you that such men are scarce. Such men are not scarce—we are a nation of born skilled mechanics. What is scarce, however, is a type of boss or foreman capable of judging. Executives for the most part get their reports on the labor situation in their respective plants from these middle men, and because these middle men are advanced more often than otherwise to positions of petty authority on qualities best described as "smooth." Their word is very likely to be inefficient—based on error in judgment. That it is so is lamentable—but it is no less so. Indeed, the hell in industry—if there is a hell in industry—is due to this fact. It makes for friction. It makes for friction by reason of the discontent which it engenders in workmen, who themselves, often keen judges of men, are keen judges of the weaknesses frequently found in the men in power immediately above them. So I say the trouble lies not in the scarcity of efficient labor. Rather, it lies in the scarcity of petty bosses and foremen of a type capable of judging correctly on labor matters.

Bosses of the "Smooth" Type

Too many men of the other type are occupying positions of authority in the industrial world today. They may be, and frequently are, good judges of work when that work is turned out. But when it comes to judging the man, or men, who turned out the work, they are what is technically known as "flivvers." They won to their present incumbencies, as I have said, on qualities that are best described as "smooth." They are likable—possessed of the thing that makes them acceptable to those above them—have, in a word, a something that makes for success in a social way rather than in an executive way. As a situation it should not be. The qualities that make a man a success in a social way do not always make for his success in an executive way. The contrary is usually true, I should say.

A man given to correct analysis of men and measures is more often than not a man of independent thought and action. He generally is a man impatiently intolerant of sham or buncombe or chicanery, and, because he can detect these as far as he can smell them, he frequently is rather more rugged than smooth in his intercourse with men. Which of itself, and quite obviously on the face of it, checks advancement. Such a man is generally unpopular. Men twist about uneasily under his searching gaze. They judge him to be without diplomacy, do not like him, refuse to elevate him to a position of authority. In this they err. For such a man would make the best kind of petty boss or foreman. He would be coldly fair where fairness was due. Contrarywise, he would be critical where criticism was in order. And because of his knowledge of men and measures he would make few mistakes.

An Incident from the Drawing Room

I once knew a man whom I shall call Mr. Sparrow, because Sparrow was not his name. Sparrow was one vast ingratiating smile—to twist a Dickens phrase—and he was a sort of go-between, a runner, out of the chief engineer's office. That is to say, Sparrow was active between the chief engineer's office and all departments operating under this office. One of these departments was the drafting-room, of course, which was without an established head at the time, owing to the fact that the organization was a new one, and matters were in a state of confusion more or less. The drafting-room carried a small corps of draftsmen, and because Sparrow walked with a sort of hitchy gait, the boys early had tacked this nickname upon him.

One Saturday morning, as the draftsmen were bent over their boards trying to get a job cleaned up so they could get away for the afternoon, Sparrow entered the room with his usual crowhop, carrying in both hands some blueprints and sketches. He was smiling, as usual—his superior sort of smile. He stepped over the threshold actively, and, breezing over to one of the drafting-boards, slapped the blueprints and sketches down upon it. Then he gazed around over the men with the air of one about to bestow favors upon undeserving relatives—or something. Presently he gave utterance to some words. Said Sparrow:

"Fellows, we're working tomorrow."

That was all.

It was all he said. Yet instantly every head in the room lifted, and in every eye there was a look of pronounced belligerancy. The organization was one that paid off semi-monthly, and, while it did not pay for overtime it did pay for holidays and days off, and consequently was not an unsatisfactory institution at all to work for. Nor were the men a dissatisfied group of workmen. They had toiled long hours overtime on a number of occasions; and more than once had spent Sunday in the office. So it wasn't the men. Yet that little announcement of Sparrow's whipped them into a feeling of instant rebellion. It was not what he said; it was the way he said it.

For one thing, he was not bestowing a favor upon the draftsmen, although his whole manner and tone of voice indicated that he believed that he was. And yet he himself might not have felt that way about it. He was just a poor judge of humanity. For it brought on trouble later. Not one of the men came to the office the next day, Sunday, and one of the men even failed to appear Monday morning. Tuesday this man presented himself quietly and handed in his notice. Evidently he had feared a wrathful hand and had secured himself against it by getting another position. Nor was that all. By the following Saturday two other men had quit the concern. And all because of a lamentable lack of insight into character on the part of a petty boss. No doubt Sparrow reported to his chief, when the matter was brought up, that draftsmen, good draftsmen, were scarce, and labor troubles were common anyway.

Efficient Labor is Truly Plenty

Labor we have in plenty, and efficient labor we have in plenty also. And there is a deal of satisfaction among the majority of workmen. But the more capable a man is the more quickly will he become offended over errors in judgment concerning himself on the part of his immediate superiors. Nor will such a man remain satisfied for long under a petty boss or foreman whose qualities for holding the job are a ready smile and a neat trick of turning a witticism when greeted by a superior.

Sparrow was the other kind—I am inclined to linger on this element bearing on labor in the industrial world, because of its very great importance, and because also it has not been given serious consideration. Sparrow was not a judge of men. He held his position, as was plainly evident, by reason of an ingratiating manner toward his superiors. The chief unquestionably liked Sparrow. Sparrow himself unquestionably was a success in his own little circle of friends and acquaintances outside the office. No doubt Sparrow was "there" in that poignant way which is sought and accepted as marking a man "eligible" in our narrow social circles. Sparrow could probably tell a good story, if need be, and perhaps could carve a roast or flop off a turkey wing or leg with due skill. But when it came to reading with sure effectiveness the character and whims and foibles of men not of his protracted acquaintance, he was more than a bull in the china department—he was a downright nuisance and a loss to the concern. Yet how could the chief, as Sparrow *was* the sole medium between the draftsman and the chief—how could the chief know that? Especially if the chief was a poor judge of men, as is not infrequently the case.

Poor Judges of Men

Show me a concern that is always having labor troubles and I will show you a concern that needs reorganizing from the top clear down to the bottom. The workmen themselves may remain. They have nothing to do with the system in vogue in the plant. All they have to do for the returns accruing to them every week in an envelope is to turn out a certain quantity and quality of work. Dissatisfaction may be theirs, or it may not be theirs, depending upon certain things. But of one of these things executives may be assured. If dissatisfaction is theirs it is because of more or less constant friction between themselves and those immediately over them.

This is due to faulty selection of petty bosses. Faulty selection of petty bosses is due to faulty selection of foremen. Faulty selection of foreman is due to faulty selection of superintendents. Faulty selection of superintendents is due to faulty selection of managers. And so on, although this thing today is being remedied through so-called "employment managers." The innovation is wise, if the employment manager has been well selected, as he will be if the manager has been.

Sparrow's Error of Judgment

Let us return for a moment to Sparrow. Had Sparrow put his announcement this way: "Fellows, the chief wants you to work tomorrow," and had said it with a quiet smile; or had he said, "Fellows, it looks pretty much as if we're all slated to work tomorrow," and had said it with a sober countenance; or had he said, announcing it modestly: "I don't like it myself, boys, but the chief is being pushed for this job, and if you could manage to come down in the morning, he would consider it a very great favor to him." I say, if Mr. Sparrow had come into the drawing-room and made his announcement in a fashion following any one of these, the response, I verily believe, would have been favorable, and the gang, to a man, would have been on the job the next day—and no trouble. But no, Mr. Sparrow breezed into the room, slapped the sketches and blueprints down upon the table, and by manner and tone of voice and ill-selected choice of words gave the draftsmen to understand, willy-nilly, that they were to work the next day. He did not understand his men.

Efficiency and Judgment

Which brings me around to the efficiency side of this question. Efficiency is a thing pretty well understood today—that is, the methods for gaining greater efficiency are fairly well understood. Efficiency organizations each have their own pet tricks, and all of them have to do with ways of doing a thing to effect savings in time and material. Most of them fasten their attention upon labor—the human element—and after getting this element well in hand they turn their attention to routes and machines and the manifolding of papers. That they realize the importance of skilled labor to effect satisfactory results is obvious.

That nearly all attempt to crowd an organization of workmen through the same gage of sieve is also apparent. That it can't be done, many have learned to their utmost dismay. Workmen cannot be handled successfully in groups, any more than children can be educated successfully in groups. Educators are coming to recognize this great truth, and industrial men of affairs also must come to recognize certain truths—of themselves well-known among the lower strata in industry—in their own game. A man is an individual, a unit, the composite of thousands of ancestors.

YOUR WAY NOT HIS WAY

You cannot make an ox saw wood. Not as you yourself would saw it—directly. But this you can do. You can purchase a circular saw; belt it to a treadmill; lead your ox into this; tie him fast to the bar; throw off your clutch. The ox will feel himself slipping, and will begin to mount the endless wheel—and saw your wood for you. But please notice. He will saw your wood in *his* way and not in your way. You understand what your way is. Your way is to throw a length of four-foot stuff into a sawbuck; lay firm hands upon your trusty bucksaw; and fly to it, making motions like a villain on a handcar making his escape from the hero on a locomotive going eighty miles an hour in a five-reel movie. But to get back. The ox is sawing the wood in *his* way.

Pretty much the same thing must be done in this matter of labor. Not that workmen in the mass at all resemble the ox. Merely, I have taken an extreme case to bring out my point. However, the work of labor is frequently that of own brother to the ox. Often it is an endless grind, having neither head nor tail, and so completely devoid of middle.

But to try to make a lefthanded man do a stunt with his right hand which without thought he would do with his left hand, is like trying to change the color of his hair by the simple process of suggestion. It cannot be done. He will listen attentively to your explanations. But when your back is turned he will calmly continue to do the thing as he has always done it, unless he is a fool. And unless he is a fool also, his way of doing it, for him, will be the best and the quickest way. Because—to flash back to my opening paragraphs—we are a nation of born skilled mechanics. That means that inherently we know "how."

AMERICAN INITIATIVE

I am minded to tell of an incident which will illustrate American initiative. It happened in an American drafting-room. Three men were assigned the job. The job was in a hurry and the work was equally distributed among the three men—an Austrian who had been in the country perhaps two years; a Serbian who had been in the States perhaps a year; and a representative of a long line of ancestors who had done their bit toward making this country what it was—and is—his family had been in America nearly three centuries. The job, as I say, was in a hurry. It consisted of tracing a great many very small drawings, about 9x12 inches in size. The chief scattered the sheets around on the three drawing boards, and told the boys to push the job.

One draftsman, the Austrian, after removing the job he was working on, tacked down one of the rush drawings, made a guess with the shears as to the size of tracing he would require, and presently was tracing. It took him perhaps five minutes to get under way. He paid no attention to the other men.

One of these men, the highly educated Serbian, was engrossed in the work of getting under way also. This man tacked down not one but three of the small drawings, covered the three with a single large piece of tracing cloth, and himself fell to work. The border lines, the pencilling off and inking in, would be taken care of later, as also would those of the job being tackled by the Austrian. Perhaps eight minutes were consumed by this man in getting under way.

But not so the third man—the American of long American lineage. Having observed the methods exercised by his two associates—with somewhat of a sardonic grin on his face—he himself got busy. He first counted the number of drawings which had been apportioned to him to trace. There were ten or twelve of them. Having ascertained the number, he then spread his whole board with a single piece of tracing cloth, laid off in pencil the size of the sheets to be traced, inked in the border lines to a number equal to the number of sheets required. Then he cut them up; laid them aside; tacked down as many of the small drawings as his board would accommodate. After this he covered each with a piece of tracing cloth—already cut to size and with border lines inked—and began, as the second man had done, to trace a whole batch at once. Needless to say, he finished his job far ahead of either of the others. He was able to do this owing to the fact that he had completed all similar jobs connected with the task at once—trimmed all sheets at once, inked all border lines at once, tacked all drawings down at once, traced all drawings at once. When the last drawing was traced the whole job was completed.

AMERICAN LABOR

Labor—American labor—is like that. Where a job requires som initiative, American labor excels. Yet I hear some executive saying that his own labor is mostly foreign and that none of his jobs call for initiative. All right—as far as it goes. His establishment may be overrun with foreigners—and probably is if it is an Eastern shop—but all tasks, no matter how infinitesmal, or how often repeated, day in and day out, require at some time or other in the process some initiative.

Personally, I never shave myself the same way twice, and I have been at it a good many years. The major processes I do indeed repeat—such as honing the razor, lathering my face and raking it down with the tool. But there repetition ends. I do the job sometimes in ten strokes, sometimes in fifteen; sometimes in long strokes, sometimes in a number of short ones. But never in the same way twice. Nor does the most skilled barber shave all his customers in the same way.

MUSCLE AND MIND

So with any task or operation performed through muscle and mind working one with the other—one under the influence of the other. The mind is really the controlling, the guiding, agency, and the mind *will* wander, at times, no matter how engrossing or how mechanical the job. And it is just here where beautiful precision of movement slips. A machinist may pick up a part from his tray, place it in his lathe and chuck it fast, set his tool and start the first cut, all as he has done the thing twenty times before without perceptible variation in his movements one against the other, and on the twenty-first time fall down to such an extent that he will lose the time he has gained. It is purely a case of mind over matter, and mind ever was and ever will be a varying and a variable constituent to be dealt with.

Organizing a Purchasing Department

Purchasing is Not Gambling in Materials But is An Important Function in Manufacturing

By G. Sumner Small

If purchasing is properly done materials are obtained when they are required, of the exact quality and quantity specified, and at the lowest price. The general methods by which these ends may be achieved are given in this article.

Mr. G. Sumner Small *is a graduate of the Polytechnic Preparatory School and the Polytechnic Institute, Brooklyn, New York. From 1908 to the present time he has served numerous firms as a consulting engineer and efficiency expert, his experience including almost every line of endeavor. He is one of the senior engineers on the staff of C. E. Knoeppel & Company.*

THE conditions of the material market brought about by the war have given industry a new conception of the function of purchasing. Before the war the question of price seemed to play the most important part, but under the new conditions the paramount question is, Can the goods be purchased and delivered by the time they are needed for manufacturing?

While the saying holds good that the first profit in a business is in the purchasing, the attempt to purchase cheaply by beating the market is frequently carried to a point where it approaches speculation or gambling in futurities. Some concerns even go so far as to encourage their purchasing agents to speculate by holding them accountable where a price fell after purchase was made, or because an additional quantity was not purchased before a price rose.

While there are several commodities, of which a good example is coal, which varies in price with the season, and in the purchase of which the purchasing agent is able to take advantage of low prices by stocking up, as a general rule speculation in purchasing materials is equivalent to speculation in wheat or in stocks, and has about the same opportunities for success. The purchasing agent who purchases at a time and in quantities in accordance with the requirements of consumption, and at the lowest quotation at the time of purchase, usually comes out ahead and best serves his concern.

In a recent case a concern lost many thousands of dollars in speculation and seriously embarassed its manufacturing department through a shortage of material, by holding off on necessary purchases because of the belief that war time prices would not hold. The executives refused needed pig iron at $22 per ton and finally covered at $46 per ton; this was but one of many materials in which they gambled on the wrong side of the market.

FUNCTIONS OF A PURCHASING DEPARTMENT

The functions of a purchasing department in the order in which the author has found them to be of the greatest importance in producing profits for manufacturers, are as follows:

(a) Obtaining the delivery of materials at the time they are required.

(b) Obtaining materials of the exact quality for the results required.

(c) Purchasing at the lowest possible price.

EXAMPLES OF POOR FOLLOW UP METHODS

One of the best illustrations in the author's experience of the conditions which may arise in a concern due to poor follow up methods in the purchasing department was a small concern manufacturing heat-treating furnaces. The furnaces were constructed almost entirely from purchased castings and parts. The manufacturing consisted largely of assembly work.

An investigation in the assembly department showed an amazing condition. Figuring roughly by weight, there was enough material on hand to construct over one hundred furnaces, but in no case were all the parts on hand that were necessary for the complete manufacture of any one furnace. The assembly department was filled with semi-completed furnaces on which work had been stopped because of lack of parts. The assembly crews had to be continually switched from one job to another as the needed parts came in, were frequently idle and the consequent assembly cost was so great that there was grave doubt as to whether the concern would be able to remain in business. The installation in the purchasing department of a simple, businesslike follow-up system corrected the difficulties and put the concern on an excellent, profit-making basis.

The manufacture of automobiles, especially those manufactured largely by assembling purchased parts, is another good example. The economical manufacture of automobiles is largely dependent on the maintaining of a uniform flow of parts through the plant, of a daily production of a uniform number of cars, and this is largely dependent on purchasing. A car cannot be completed in the assembly department unless every last necessary part is on hand. It is impossible to have the parts flow to the assembly department in the order and quantities in which they are required unless there is a comprehensive system of purchasing which obtains the deliveries of the parts needed, or the material from which the parts are to be made, at the time necessary.

The manufacturer of an excellent, though much derided small car, was forced at one time to ship his cars to dealers, minus hoods because the hoods were not on hand when required. The plant had a notably excellent planning system, but in this case failed to give proper consideration to the ability of the vendor to live up to his contract. The purchasing agent must guard against the tendency on the part of vendors to accept attractive orders for a specified delivery date, when there is no possibility of their being able to meet their promise.

OBTAINING DESIRED DELIVERIES

If a purchasing department is to be organized so as to deliver material to the plant at the time at which it is required, the following points must be provided for:

(a) The purchasing department must be supplied with information concerning the material wanted, and the exact date on which delivery is wanted, a sufficient time in advance of the delivery date required to enable them to obtain delivery on that date under the existing market conditions.

(b) The purchasing department must keep the manufacturing department posted in regard to the length of time in advance of requirements that material must be ordered to obtain the delivery wanted.

(c) Where there is any doubt of the ability of the vendor to deliver the quantity required at the time required, an investigation of the vendor should be made.

(d) The requests for quotations and the purchase orders should be followed up systematically and persistantly until the required goods have been received.

It is evidently unfair for a concern to expect its purchasing agent to obtain the delivery of material in two months' time where the existing delivery time is four months, nor can he be expected to buy at the lowest prices on short time delivery. Where a purchasing agent is forced to insist continually on exceptionally short deliveries, he becomes a pest to vendors. They may have to upset their manufacturing schedules to meet his demands, and if the vendors are crowded with orders he will be the first customer dropped as his business is undesirable.

Planning Purchasing

The purchasing agent should, as a routine matter, deliver to the manufacturing planning department at regular intervals a list showing the existing delivery time required for each of the various classes of material purchased. The manufacturing planning department is then able to arrange to plan its material requirements sufficiently in advance to allow ample purchasing time. If, after this information has been given, the purchasing agent is not given the length of time to purchase as stated on his list, and the goods are not received in time, the blame lies on the manufacturing planning department.

All requisitions on the purchasing department should have on them the date on which the delivery of material must be made. If the time allowed to purchase is not sufficient, the purchasing agent should notify the author of the requisition stating when delivery can be expected.

Reliability of Vendors

Where large contracts are made with vendors, an investigation of the ability of the vendor to meet the deliveries specified should be made. Inquiries among the vendor's customers may show that due to carelessness or inadequate planning methods the vendor is chronically late in his deliveries. In some cases the vendor is willing to be penalized in case he fails to deliver on the dates specified. The law does not allow penalties in contracts but does allow reimbursing for losses sustained. A clause may be inserted in the contract stating that in case of failure to deliver on the date specified the vendor shall pay a certain sum each day until delivery is made, as and for liquidated damages.

In times of good business vendors are seldom willing to submit to penalties and other means must be taken to assure the desired deliveries. The author has seen a manufacturing concern accept a large contract which a later investigation showed the concern was not mechanically equipped to produce and could not be mechanically equipped to produce in the time given.

The only means of protection against such vendors is to make an actual investigation of the plant capacity and organization of the concern in question. The purchasing agent is hardly fitted to make such an investigation and must arrange to have it made either by a competent man from his own concern or by an outside firm of production specialists.

Following Up Orders

The follow-up system might be called the mainspring of the purchasing department, for satisfactory purchasing service from the manufacturing standpoint is almost wholly dependent on it.

A follow-up system may be generally described as a means by which matters to be taken up at certain definite times are automatically brought to the attention of the person concerned at the time specified. The usual machinery for such a system is merely a drawer file indexed by dates. If a matter is to be brought up on a certain date it is filed under that date in this file. Each day the matter contained in the file for the date is taken out and given to those interested. In this way, on the date set the matter is automatically brought to the attenion of those concerned.

The first point to be followed up in purchasing is the obtaining of quotations. When a quotation is written for, a copy of the letter should be filed in the follow-up file by the date by which a reply can be expected. The length of time allowed naturally depends on the distance the letters have to travel, with an allowance for a legitimate time for the concern written to collect the information required and answer the letter. If no reply is received by the follow-up date another letter should be written. In many cases form follow-up letters can be used to advantage.

All purchase orders should specify the dates on which shipment or delivery is required, however, this is often not sufficient in itself to assure delivery on the date stated and concerns take further means to impress the importance of the delivery date on the vendor. An effective means is the inclusion of a clause on the order that the contract is not binding until the order has been acknowledged and the specified delivery date agreed to as part of the contract. Another harsher method is to state that, "We reserve the right to reject all goods not delivered on or before the date specified." These statements are generally printed in red so as to attract the attention of the vendor.

Some concerns have obtained good results by inclosing an extra order copy to be returned as an acknowledgment, or by having an acknowledgment slip attached to the purchase order by perforations. Either of these acknowledgment forms should contain an agreement to the delivery date specified that must be signed.

Establishing Favorable Relations with the Vendor

The purchasing agent will often obtain valuable information in regard to the best method of dealing with vendors from the sales manager of his concern. The methods by which favored customers obtain the best service from his concern will be the best methods for him to adopt in dealing with vendors. The service you obtain depends largely on the moral status you establish. If they learn that when you set a delivery date you mean business you will have little trouble in obtaining service.

The foregoing point is well illustrated by the customers of a certain foundry. One wrote rather truculent letters to which no attention was paid while a mild request from the other brought immediate action. It was explained to me that the truculent one was always in a rush but forgot all about the letter after writing it, and that they would not hear from him again if they delayed the order a month. However, when the mild one wrote it meant that he really needed the goods and they liked to oblige him.

The success of the mild customer in obtaining what he wanted was due to his adequate methods of planning and following up his purchases. He allowed them a reasonable time for manufacturing and delivering his orders, but if his goods were not delivered on time they invariably heard from him. In the unusual cases in which he requested quick delivery they knew he actually needed the goods quickly and did their best to help him out.

The easiest method of following up orders is to have an extra copy of the order written which can be used for filing in the follow-up file. This copy should have spaces provided on it for making notations of all follow-up letters.

The first matter to be followed up in regard to a purchase order is the receipt of the acknowledgment. If the acknowledgment is not received within a reasonable time a letter requesting an acknowledgment should be written. After receiving a few letters of this sort a vendor will take particular pains to acknowledge your orders promptly.

The next follow-up point is the receipt of the invoice. If you have allowed yourself a margin of safety on your delivery date, that is, if you will not require the goods for say ten days after the delivery date set, and you are dealing with a reliable vendor, you can place your follow-up copy of the order at the date on which you should receive the invoice if the goods have been shipped when promised.

If you will need the goods on the delivery date or are dealing with an unknown or unreliable vendor, the follow-up copy should be filed ahead of the delivery date, and on the follow-up date a letter should be written reminding the vendor of your order and the fact that you will need the goods promptly on the delivery date set.

The purchasing agent will find it advisable to retain in his department two copies of the purchase order and also the purchase requisition. One copy of the order should be filed in the follow-up file, the other copy should be filed by purchase order number and the requisition copy should be filed by the department ordering the goods and sub-filed by class of goods ordered

Purchasing Goods for Stock

The purchase of goods for stock should be handled somewhat differently than the purchasing of other goods.

By the usual method the stock clerk determines that additional stock goods are needed and orders the goods purchased by sending a requisition to the purchasing agent. The author has found that it is more efficient and requires less clerical labor if the stock records are maintained in the purchasing department.

In this system the stock clerk is taken over by the purchasing department. When stores issues material on a requisition, instead of entering the material given out on the stock cards, it sends the requisitions to the purchasing department where the material is entered on the stock cards by the stock clerk. When the stock clerk finds that more material must be ordered, instead of writing a requisition he merely gives the stock card in question to the purchasing agent, who writes his purchase order from it. This saves the labor of writing requisitions. The constant following up of the purchasing department by stores for needed stock goods is also eliminated as the responsibility for maintaining that stock is shifted to the purchasing department.

The entering of the stock requisitions on the stock cards keeps the purchasing department in constant touch with the quantity of stock on hand, and if there is an unusual run on any stock goods they are aware of it and are able to hurry in their purchases of the goods in question.

For convenience in purchasing, space is provided on the stock cards for entering the full purchase specifications of the material they represent. There is also space at the top of the stock card for entering the names of the vendors from whom the goods may be purchased and their quotations. This saves the purchasing department the work of keeping a separate file containing these data, and gives them a ready record by products showing vendors, prices, specifications, last purchase price, date of purchase, quantity ordered, date ordered, date received and also the quantity of the goods that is being used.

Carrying the Least Stock Necessary for Requirements

As the purchasing department is responsible under the system outlined for maintaining an adequate amount of all stock goods on hand, it becomes its function to determine the minimum amounts of stock goods to be carried, and the amounts that shall be ordered at one time. The definition of the minimum amount of stock to be carried is the lowest amount to which the stock is to be allowed to fall before more goods are ordered. The minimum amount should be a quantity of goods sufficient to last until more goods can be purchased and delivered. This quantity is evidently dependent on the quantity of the goods which are being used in a given time and on the length of time which it takes to purchase more goods.

To set the minimum amount for any item of stock goods the purchasing department determines first the length of time which will be required to puchase the goods and have them delivered. When this has been determined the stock card is referred to and the quantity of goods withdrawn from stock for an equal length of time are determined from the entries on the card. This amount plus an additional amount for a margin of safety in case delivery is slow is set as the minimum amount.

The minimum amount when set is not final and must be changed whenever conditions change. Whenever entries are made on the stock card, the increase or decrease in the use of the material should be noted and, if considerable, the minimum amount to carry should be increased or decreased in proportion. When the time required to purchase certain classes of goods changes, the stock cards for that class of goods should be removed from their files and their minimum amounts should be changed to meet the new conditions.

The amount of any stock item that should be purchased at one time is ordinarily set at a quantity equal to the minimum amount. When this is done the stock on hand and the investment tied up in that stock is reduced to the lowest possible figure. There are, however, times when this procedure is not advisable such as where a decrease in price or a carload shipment can be obtained by a reasonable increase in the amount of the order.

The method of determining when it is necessary to place an order for stock goods is as follows. When the stock clerk enters on the stock card the withdrawal of material and finds that the withdrawal reduces the amount remaining on hand to or below the minimum amount, he withdraws the stock card and passes it to the purchasing agent or his assistant who writes a purchase order for the amount to be ordered. The concern ordered from, the amount ordered, the price and the date are entered on the card, and it is returned to the stock clerk. When it is returned to its file a clip signal is attached to it and remains on it until the goods ordered have been received. By this means all stock cards on which there are outstanding purchase orders are distinguished by a flag and can be more readily located.

Purchasing to Exact Specifications

One of the greatest savings that can be made in purchasing is by purchasing to the exact specifications which are the best suited to the intended use to which the material is to be put. The fault of buying material of a far better quality than is necessary for the intended use is frequently met with. On the other hand as great a loss is often sustained by buying materials of too low a quality. This results often in material waste, or in excessive labor cost in working up the material and frequently means dissatisfied customers.

In a silk ribbon mill, what appeared to be an evident saving was made by buying an inferior quality of silk. Investigation showed that the delay to looms and loss of production from the additional breaking of threads with the inferior quality of silk as compared with the better quality amounted to many times the extra cost of the better grade of silk. In addition this meant a better product and more satisfied customers. There were, however, more expensive grades of silk yet which investigation showed it did not pay to use as the additional strength and reduction in thread breakage would not pay the additional cost.

In another case the author made a saving for a brewery by purchasing their coal to specification as to the heat units per pound and the allowable percentage of sulphur. Under the contract as drawn up a bonus was paid for coal better than specifications and rebate was given when the coal fell below specifications. The contract was made with the same company that had previously supplied an extremely poor quality of coal, and was closed at the same price that had been paid for the coal formerly supplied.

For every use there is an exact quality of material which best serves the purpose. To find this quality careful consideration must be given to cost as compared with reduction in waste, saving in manufacturing labor and improvement in durability or appearance of the finished product.

The more modern large plants are usually equipped with laboratories where the exact suitability of the various grades of material for the intended use are determined and purchase specifications drawn up. These laboratories also sample and test all incoming material and determine if it is the quality ordered. The testing of purchased goods for quality is as important as weighing or counting them for you pay for quality as well as quantity.

While the purchasing agent is usually not in a position to start and manage laboratories for the testing of goods, he can at least show the management the importance of such a step and the probable savings to be effected.

A start in the right direction can be made by listing a number of the purchased articles and questioning their quality. As examples, pencils can be purchased from a cent a piece up. Is the quality you use one that gives satisfaction and is it the cheapest that will give satisfaction? Is the quality of paper used in letters and forms consistent with the use to which they are put? An analysis of purchased goods will often prove surprising in showing up useless waste, and will lead to savings

Reducing the Variety of Goods Purchased

Concerns frequently buy a variety of goods far greater than is necessary to meet all their requirements. This arises sometimes from lack of standardization in the designing of their products and sometimes from allowing each department to order supplies in accordance with particular whims. The results are a very much larger stock than is necessary, the ordering of goods in small quantities at higher prices, and often the turning out of finished products for which it is difficult for the customers to obtain repair parts.

This inefficiency can also be readily shown up by analysis. Compare the types of certain articles used by the various departments. Is there any reason why they should not all use the same type? Analyize any special articles or special sizes or qualities of articles that are purchased. Is there not a standard article that would answer the purpose just as well? Analyze the variety of types, sizes, or qualities of a purchased article. Is there a sound reason why so many kinds are used, or is it just carelessness? An analysis of this sort will repay you many times the effort expended in savings effected.

Buying at Lowest Prices

As has been before stated, the holding off of purchase or the purchase in advance because of the belief that prices are going up or down, is dangerous and closely akin to speculation. There are some keen judges of business conditions who may profit in this way but the average man would do well to leave the speculative side of purchasing strictly alone. However, there are legitimate opportuinties for cheap purchasing at quotations below the market prices and the purchasing agent should keep closely in touch with market conditions through the trade papers pertaining to the goods purchased.

The price at which a purchasing agent is able to buy goods is dependent on the current prices at the time of buying and the size of the market from which purchase is made. The more vendors a purchasing agent deals with the more liable he is to be able to purchase at the cheapest price. Except where prices are standard there is one concern selling the article you want which is quoting the lowest price. If that concern is not on your list you will not purchase at the lowest price.

Whenever an advertisement is seen of a concern selling any of the articles you buy, but not on your list it should be added to your list and quotations written for. If they sell goods that you carry in stock, their name should be entered on the stock cards of the articles in question. If they sell goods purchased but not carried in stock, their name should be entered on the vendors card for the articles in question.

The foregoing gives, in brief, the principles on which the author has reorganized many purchasing departments. The giving of the details of systems and forms has been avoided as they seldom apply to any but the particular conditions for which they were designed. Principles are universal and particulars should be carefully designed in accordance with the principles, but made to fit the individual needs of the case in hand.

Measurement of Management

By Frederick C. Coburn

Naval Constructor U. S. N., Manager Naval Aircraft Factory

LET us consider the stockholders viewpoint first. The stockholders are the owners of business. They have invested capital in it and naturally look for a return, and it is by the relation between the amount of this return and the amount of capital invested that they judge the management or the efficiency of management. There are many evils arising out of this habit of stockholders, especially when there is a condition of absentee ownership. There is a tendency to run down the plant, to maintain interest and dividend payments, and do certain things in order to support the market value of securities. Stockholders are uneducated as a rule in regard to matters of industrial management and think that whenever wages are raised dividends go down.

It would be well if there was some way to get stockholders to study the balance sheet so as to be sure the plant has been maintained, and to have some way of learning the effect of raising wages, provided the raise is based on a *quid pro quo.*

The Customer's Viewpoint

The customers, or what is the same thing, the public, look at the quality of goods produced in connection with the price; that is, they want quality at a price and at the same time they consider deliveries and service. The matter of service is becoming increasingly important. Intrinsically, so-called service is worthless, for if the company does the job right the amount of service needed should ordinarily be small, but it makes the customers feel good and, although expensive, appears to pay.

The Employees' Viewpoint

The average employee wants first a steady job, so that he may know how much he has coming in each week and can adjust his scale of living to it. Next he wants good wages, that is, as good wages as other people engaged in the same kind of work receive. Next, he wants fair treatment from his employers, and finally he thinks of good working conditions.

The Banker's Viewpoint

The banker is drawn in because he is asked to lend money to the company. Before he makes a loan he wants to see the balance sheet and then his first thought is the relation between the amount of quick assets and the amount of quick liabilities. He then becomes interested in earnings, dividend records, appraised value of the property and depreciation reserves.

Industry has not yet recovered from the banker's idea that the efficiency of industrial management can be judged by the relation between the amount of "non-productive labor expenditure" and the "productive labor expenditure." This method probably arose out of the practice of judging the efficiency of the management of a railroad by the relation between operating expense and earnings. There may be some value in this criterion, but the relation between overhead expense and productive labor has nothing to do with the efficiency of management. Nevertheless the effort to make expense small with reference to the productive labor pay roll has held back the development of organization and proper management as much as any other one thing.

The Creditor's Point of View

After the creditor has considered the company as a credit risk and made a loan, he judges the company by its promptness and regularity of payment.

The Management Expert's Viewpoint

One who is interested in the subject of management and has made a careful analysis of the job, sympathizes with each of the above groups. Some of their criteria may not be good, but on the whole the business is actually judged from all those viewpoints, and the business must be made to look right from all of them.

Assuming that we have the five general functions of management, namely, sales, engineering, production, financial and legal, these criteria may be distributed to show what each function is responsible for: The sales department for deliveries, service, steady work; engineering department for quality, service; production department for maintenance of plant, quality of output, deliveries, steady work, wages, treatment of employees, working conditions; financial department for dividend record, balance sheet, promptness of payment; legal department for attitude toward the public.

With the responsibilities of the sales department this article will not deal. The responsibilities of the engineering department fall without our present consideration. The financial and legal departments likewise are not for us to discuss here.

But the production department is our field and we shall try to show that competent people in supervisory positions, with proper organization, good control and fair knowledge of facts, will do their jobs and form the foundation for the sales, financial and engineering departments and general administration to lean upon.

It is not well to set up any one criterion by which to judge the efficiency of the management of the production department but rather to consider that we have seven criteria. Nearly if not all of these may be lumped together in the general term of *control.* Then the complete control by people who are earnest, thoughtful and doing their job will produce methods of management which will measure up well by any criterion.

A Few Examples

There is a cotton mill in a certain state which violates nearly all these seven criteria. It does maintain plant, quality of output and affords steady work; but in deliveries it is execrable, the wages are abominably low, the subject of treatment of employees is given practically no thought, and the working conditions are by no means satisfactory. Looking at the plant one finds an excessive amount of material in progress, lax methods of time keeping, a piece rate system of payment based on the principle of limiting the earnings of the employees, but at the same time getting the maximum output.

At another textile mill there is really no coördinating head, no central control, the various department foremen run their own departments in their own sweet way. The plant is run down, is unsanitary; and there is no thought given to the development of personnel.

At another plant, a machine shop, the management is excellent from a technical point of view; the plant is fine; they have unusually good sales; and yet realize about one-third the proper production because no one in the firm understands how to keep work moving.

In any one of these cases a central control vested in a manager who is earnest in doing his job, capable and acquainted with what other people in the industrial world are doing would correct these conditions.

Dividend Record No Criterion

The dividend record is no criterion by which to judge shop management, because dividends may be made even though shop management may be abominable. The relation between expense and productive labor is no criterion of management because it puts a premium on inefficient management. The less expensive the plant, the less money spent on supervision, planning of work, provision of suitable equipment and proper tools, the smaller will be the expense; and the poorer the labor and slower in work, the higher will be the labor cost per unit of output. With these conditions obtaining the ratio between expense and labor is small.

The suitability of the plant, its buildings and real estate, its location with respect to the labor market, transportation facilities, material market, etc., are all criteria by which to judge the founders of the business, perhaps, but are wholly useless by which to judge the present operators of the plant.

Employment and Labor Maintenance

A Special Department to Aid Employment Executives

Standardization of the Causes of Leaving Jobs

By J. D. Hackett

Industrial Counselors, Inc.

In attempting to reduce labor turnover, the investigator's first impulse is to ascertain why men leave work because success in the undertaking is mainly dependent on this knowledge. Accurate tabulation of the cause of leaving not only indicates definite remedies for turnover but shows conclusively whether men are eligible for re-employment. Since some firms re-hire as much as twenty per cent. of their men the cause of their departure, in the first instance, should be definitely known and put on record, otherwise unsatisfactory men may be taken on again. It should, therefore, be the ambition of every employer to have a statistical compilation as to the cause of leaving in his hands at the end of every month, so that he can discover facts which promote intelligent turnover reduction.

Unfortunately the wisdom of securing this information has not always been recognized and the fault is principally due to undeveloped employment methods Even where centralized employment offices exist, the subject has not been valued at its true worth. Two things, therefore, seem desirable: A standard list of the causes of leaving; a standard terminology.

Definition of Terms

In the first place it is well to remember that the word "leaving" refers to departure from whatever cause. Those who leave are divided into four major groups: quit, laid off, discharged, strike.

The term "quit" applies to men who leave voluntarily, either because conditions of work or pay are unsatisfactory at the plant or better elsewhere, or for some extraneous reason. In certain firms a distinction is drawn between the above term and "resigned." In one case a man leaves without notice, in the other due notice of intention is given.

Men are usually "laid off," permanently or temporarily as the case may be, because of lack of work or because they are unsuited in some respect through no personal fault or for the sake of discipline. A distinction is sometimes made between men laid off for a determinate or indeterminate period. In the former case men are put on the absent list. With the exception of men who are forced to retire through reaching the age limit, all are eligible for re-employment.

The term "Discharged" indicates only men who have been forced out by the employer "for cause." "Dismissed" is, perhaps, a better term though it is not so commonly used. The remaining group comes under the heading "strike."

The day is rapidly approaching when the employer will demand monthly returns of his shifting labor with full and exact details as to the cause of leaving, which will be considered as important as production sheets are now, but, though many executives know their approximate annual turnover rate, not one in a thousand has the remotest conception of the relative amount of those who quit, those who are laid off and those who are discharged, and the significance which the increase or decrease of those figures indicates.

Summary of 100,000 Causes

In an examination of a hundred thousand causes of the reasons for leaving work, in some of the more representative plants of the country, it was recently found that 74.6 per cent. quit, 12.2 per cent. were laid off and 13.2 per cent. were discharged. The large majority of existing statistics are almost worthless, however, because there is seldom a proper classification and the assigned cause is too vague in many cases. Much, for instance, is left to the imagination when one is told that a man was discharged because he was "unsatisfactory," "unreliable," or "unsuitable," yet these are the typical phrases under which foremen often take shelter. If specific reasons, well known to the foreman at the time, were indicated, indiscriminate discharge would be minimized considerably.

In one firm where explicit directions were given as to the correct method of making returns, the following interpretations were received from the foremen: "No like work," "no good," "service no longer required," "too much money, this fellow," and so on. Under the heading "Quit" men were described as "going away," "Dissatisfied," while many "worked notice" and "resigned." This will be the result as long as the foreman is allowed to choose his own words. The only remedy is the establishment of a standard method for recording the facts and the provision of the machinery whereby they may be obtained.

Another difficulty arises in the case of men from whom no reason for leaving has been obtained. This was found, in a recently investigated case, to amount to over 60 per cent. of the men who quit and 19 per cent. of the men who were discharged. While it is sometimes difficult to obtain the reason when men quit without notice, no such contingency should arise in the case of discharge because a man cannot be discharged without some one being responsible.

Subdivisions of Main Groups

Having divided those who leave into four main groups, further subdivision remains to be considered. It would seem, from an examination of the records of a number of plants, that men who quit may be placed conveniently in three classes.

Quitters
(a) Work.
(b) Pay.
(c) Personal reasons.

It is undoubtedly of value to the employer to know the nature of work to which his employees object so strongly that they seek another job. Intrinsically it may be impossible to improve conditions or the cost may be prohibitive. On the other hand the records may show that the turnover cost may be actually less than the cost of improvement. If men leave, as occasionally occurs because of wet floors; drainage, possibly at a trifling expense may remedy the trouble. If a girl "objects to the smell of glue" it will be easier to remove the girl than the smell.

Many men quit work because they have a better job elsewhere, and the wise employer will seek to ascertain in what respect his work is inferior. Other men will consider their work too hard or too monotonous; they will object to part time, short time, delays in getting material, night work or continuous Sunday work; they may consider the work dangerous and the risk involved too much for a family man; they dislike excessive dust, heat or fumes; they insist on warmth, good drinking water, modern sanitation and so on. All of these, which are the most usual, should be carefully classified under the main heading "Quit Work."

Frequently men quit because their pay is too small or, conversely, because it is better elsewhere. Another objection is against docking or fines. Some quit because there is no extra reward for overtime, no prospect of an increase, because pay is reduced or the system of paying is faulty.

Progressive employers find it advantageous to know how many of their men leave on account of pay, particularly if the number shows a gradual monthly increase. Whether a man thinks he is getting too little or believes he can get more elsewhere matters but slightly; the circumstance indicates that the employer should consider the revision of his pay schedule and thus avoid a strike.

PERSONAL REASONS FOR QUITTING

Of the personal reasons for quitting work there is no end. One foreman, on being asked to make a tabulation, said if there were a thousand men leaving they would have a thousand different excuses for the move. This is largely true, but many of the differences are merely verbal and unessential. If a man complains he must leave because the work hurts his back he may be properly described as physically unsuitable unless the fault is with the work and not with the man. That men "move away" is hardly precise enough to be of value and is unimportant unless it has something to do with the plant. It is an entirely different matter if housing conditions make it necessary for a man to change his employment. A large loss of employees on this account may force the employer to consider a proper housing scheme in order to stabilize his working force.

Just now a considerable number of men leave work to join the army, navy or some other branch of the service. All of these may be classed under "Government service." Illness in one form or another was frequently found on the records of the plants investigated. Some firms very properly draw a distinction between occupational disease and sickness not directly due to work, also between accidents happening inside and outside the plant. Men who leave on account of accident or illness outside the plant are classified in the quits, otherwise they are laid off.

The natural ambition of every employer is to lay off as few of his men as possible through lack of work. The immediate gain through dropping men may be more than neutralized in the cost of hiring and training others to take their places when work picks up. The number of men laid off should be as small as possible. It is an evidence of good planning. Seasonal work in some plants causes considerable lay-offs but this has been minimized greatly by good management.

Men who are temporarily deprived of work by way of discipline are placed in the laid-off column and the exact cause, in each case, should be recorded. This is a convenient place to put such cases as those in which men are found unsuitable through faulty employment methods or because they do not quite fit in with the scheme of things. If men have "trouble with the foreman" or anyone else the matter should be defined.

CLASSIFICATION OF DISCHARGE

The classification of discharged men may be arranged in two groups.

Discharged (a) Work.
(b) Personal character.

It is not always easy to decide whether the effect of work on the character, or character on the work, is the determining factor, but a personal knowledge of the circumstances usually decides the point.

The reasons for discharge as regards work are numerous but can be roughly grouped under a convenient number of headings. It is not advisable to have a separate heading for such closely allied terms as, careless, indifferent, neglectful and the like, any more than for men who are lazy, unwilling or loafers. So long as there are no standards to go by men will be discharged for a number of slightly different reasons which might better be grouped. For instance, unsteady and inattentive men may be put together in one group, while incompetent and incapable men may be placed in another. General terms, however, should be avoided.

Classification of reasons for discharge due to personal characteristics is not difficult. Under one group may be included those who are quarrelsome, fighting or merely disagreeable and men who "can't get along"; under another the grafter, borrower and the "dead beat"; so with the drinker whether he is described as intemperate, unsteady or a booze fighter. Dishonest men, pilferers and thieves should be classed together, as should the insubordinate and disobedient.

TEMPORARY ABSENCES

In some places men are granted what is known as an "accommodation discharge" which, in fact, is not a discharge at all. It is merely a subterfuge to enable a man to get his money in a hurry and in a few days, as a rule, he is back at his work again. This is only a case of temporary absence. In this connection there is sometimes a difficulty in differentiating between those who quit and those who are temporarily away. For the sake of getting immediate statistics it is well to assume that all men have quit unless the reason for the absence is known. This has a good effect in minimizing absence without permission.

How Do You Check Up Employees Who Leave?

Mr. Royal Parkinson, Employment and Employees' Service Manager, American Optical Company, Southbridge, Massachusetts, states one of his payroll problems in the following letter:

"Where can we find assistance on a payroll problem? In particular what means do large concerns have of knowing immediately when workers leave them without saying so?

"With us a large percentage of our losses occur in this manner, and the situation created is a hindrance to the application of our policy of interviewing all leavers. These leavers obtain their final pay by calling for it among the invalid and idle after a week's absence. One method that has been suggested is a visit to the homes of all those who absent themselves more than one day to determine the cause of the absence. I am under the impression, however, that in some firms a system of pay checks controls this situation."

Readers of INDUSTRIAL MANAGEMENT are invited to send in for publication a description of the means they use in overcoming this employment difficulty and assist Mr. Parkinson and other employment managers.

Taking Stock of Ideals; A War Measure

By Mary B. Gilson

Employment and Service Superintendent, The Clothcraft Shops

JUST as it is necessary to take stock of materials both raw and manufactured so is it of equal importance for business men and women to take stock of ideals and practices. Often the daily routine swings us from detail to detail with such continuity that we find ourselves acting according to tradition and precedent without sufficient attention to underlying reasons. "Writing is recording, not living," said Mr. Britling, and yet he found stock-taking an inseparable function of life itself. Whether we define the aims and purposes of our daily job in writing or not, it is necessary to define them mentally, to achieve action.

Stock phrases are frequently by-products of stock taking. So "The four walls of the home" became objectionably trite when women awakened in increasing numbers to the broad ramifications of these four walls. "Making men, not materials alone" similarly evidences the results of stock taking; results which prove that industry is awakening to the many ramifications of the "four walls of the factory." In increasing numbers industrial managers are recognizing the connection between what goes on in their establishments and the very life of the community itself.

Making Men For Community Well Being

Perhaps no member of a business organization has more direct duties in connection with man making and consequently with community well being than the employment manager. It is from him that the worker must get a clear idea of his responsibilities toward the organization and the organization's responsibilities toward him. It is his duty to see that the worker gives and receives a square deal. Most important of all, the employment manager with any breadth of vision recognizes what an integral factor he may be in reducing antagonism between employer and employee and in establishing honesty in the relationships of man with man.

The Employment Manager Must Be Honest

The employment manager who is careless in the employment of minors is dangerously undermining the respect of the worker for law, as well as nullifying any good his organization may be doing for the improvement and development of the workers. No young girl or boy who is carelessly admitted to an organization without sufficient investigation of his or her age can possibly have any deep lying respect for that organization. No matter how ignorant and immature a girl may be she is aware of the fact that the man who employed her illegally is being guided by the need of the hour and not by honest motives. And this results in a very natural distrust of business and business ethics. No factory inspectors, no truant officers, no school laws however well enforced, can possibly be effective without the honest and unending support of the man who "hires and fires." And he must ever keep in mind not only that it is a sense of personal honesty which must inspire him but also that he is playing a most important part in breeding honest workmen by not permitting himself to "play crooked."

The Employment Manager Must Not Misrepresent

Luring people from job to job is another crime against the community. It is not necessary to enumerate to the readers of Industrial Management the evils of drifting and the gradual manufacture of unemployables by subjecting them to recurring periods of unemployment "between jobs." Yet, how many employment managers who do not take stock are guilty of advertisements which misrepresent, or of recklessly and selfishly offering a job to a man who already holds a better one? It takes only one or two such experiences to plant a very definite growth of antagonism against "capital" in the breast of the average worker, for to him "capital" comprises the man higher up, and his feelings are due entirely to his cumulative experiences in the working world. "Don't bother to give notice to your present boss. We need you tomorrow morning and can't use you if you don't come then," is the advice of the employment manager who never has time to take stock. Later he wonders why workers are so "mean and irresponsible as to get up and leave their good jobs without giving him so much as a hint."

But encouraging an applicant to be on the level with the concern which he has not yet left is not the whole story. It is equally important to define clearly and lucidly the earning opportunity and the chance for advancement of the man who is considering the job you hold out. Business ethics are still very shadowy on this score. Anyone with imagination cannot help feeling a good deal of sympathy for the young person who goes with high hopes in search of a job only to be met with flowery generalities and no definite and specific information. Business organizations as a whole are still in the infantile stage when it comes to a clearly mapped out scheme of promotion and an efficiently conducted system of instruction. All who have had experience in hiring know how much the success of a worker depends upon opportunity for advancement and the definite pointing out of steps. Here is the occasion for unqualified frankness and honesty. Applicants justly complain of leaving their last jobs because they "made no headway and no one told them why they didn't." Candidly, I think this is frequently due to our negligence and to our *laissez-faire* methods.

Remove the Bitterness at Leaving

Always keeping in mind the responsibility of everyone conscious of modern sociological conditions to do his bit toward eradicating antagonism in the world of industry it is absolutely necessitous for the employment manager to see that the "final parting" is as free from bitterness as possible. This does not mean that it is wise to smooth over issues to the point of beclouding them, but, when every attempt to develop a worker has failed, it is at least worth while to know that he has left with no bitterness or feeling of unfairness in his soul and that for the sake of his future success he understands definitely and clearly wherein he failed.

It is the policy of the management of our organization that we superintendents and foremen are wholly responsible for "getting across" and leaving right impressions and it is a wise policy. The basis of this policy is the saying that "To bear conviction, be convinced yourself." The man who is not basically honest and who is not convinced heart and soul of the rightness of his argument cannot convince the stupidest of men.

"Get Across" Economic Truth

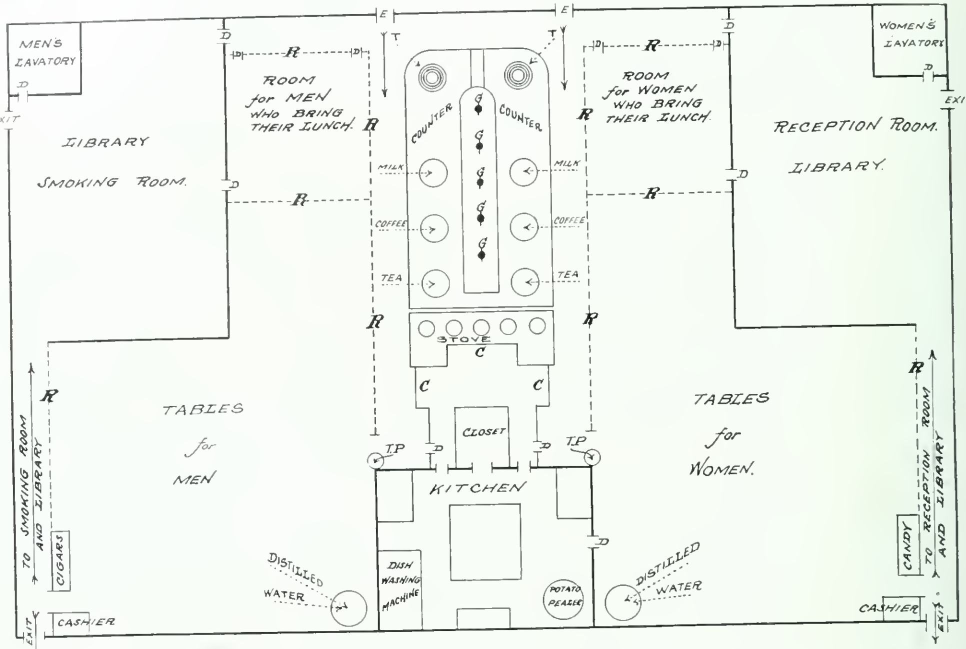
As the war goes on we shall find it more and more necessary to take stock of our business ethics; our standards of morality will have to be more and more closely defined. Russia is today facing problems of national import but these national problems have evolved from individual ones.

Factory Employees' Restaurant

By C. S. Rossy

Employment Manager, Norwalk Tire and Rubber Company

A RESTAURANT for factory employees always proves to be a profitable investment when properly managed. The employee receives wholesome food at a reasonable price, the employer finds himself the gainer in the increased energy and greater production of the individual worker. If the restaurant is made self-supporting, a condition that is always possible, the initial expense involved in its installation is negligible and eventually becomes entirely cancelled; the restaurant becomes both directly and indirectly a source of revenue.



"HELP-YOURSELF" RESTAURANT PLAN—C—CHEFS D—DOOR E—ENTRANCE G—GIRL R—RAILING T—TRAYS T.P.—TICKET PUNCHER

Why have so many factory restaurants been failures? The reason, in the majority of cases, is the lack of an efficient working plan. Realizing this, I wish to present a brief outline of a "help yourself" restaurant plan which has brought success. Its time saving quality renders it especially valuable when a large number of people must be served quickly.

The accompanying diagram shows the plan. There are two entrances *E*. The employees walk in line by the counter in the direction of the arrows, each picking up a tray *T*, and selecting such food as he may desire. On the counter may be found bread and butter, crackers, pies, sandwiches, cold meats, etc., all of which are arranged on plates before the restaurant is opened. The duty of the counter-girls is to keep a sufficient amount of food available, and to furnish the employees with such beverages as they may desire—tea, coffee, milk, buttermilk, etc. The chefs *C*, at the stoves, serve hot food—soups, beans, vegetables, meats, etc.

Having put his selection on the tray, the employee passes into the dining-room at the entrance to which stands the ticket-puncher *TP*, usually a girl. She notes the contents of the tray, punches a ticket indicating the cost of the food, and gives it to the employee, who then sits at a table to eat. At the conclusion of the meal, the employee as he leaves the dining-room pays to the cashier the amount marked on the check.

It is advisable to have two rooms to which men and women, respectively, can eat lunches brought from home. Places of this nature, conveniently located, increase the trade of the restaurant as the occupants are often stimulated to purchase more food. It is also desirable to have a resting room for women and a smoking room for men near the restaurant.

On the walls should be posted the menu for the day with the price of every item. It is advantageous to distribute printed menus as the employees go out in the evening, in order that they may know what is going to be served in the restaurant the next day.

The following menu is representative of food that may be served at a factory restaurant:

Vegetable soup	$0.05
Tomato soup	.05
Smoked pork tenderloin	.15
Roast veal	.18
Ham and beans	.15
French roast	.15
Mashed potatoes	.05
Pies, cakes	.05
Tea, coffee, milk	.05

The initial cost of establishing a factory restaurant, and the actual expense involved in maintaining it, will, of course, vary with circumstances. The following figures were obtained by the writer from the records of a restaurant patterned after the one described, and now being operated by a factory employing about 2400 hands. There is a daily average of 700 patrons. The total monthly running cost is from $1200 to $1300; the total monthly income is about $1400. The initial cost for quarters, machinery, and all conveniences such as tables, chairs, china, cutlery, etc., was about $4000.

The staff necessary to conduct this restaurant is:

	Weekly Wages
One chef	$20
One assistant	14
One dishwasher	10
One porter	12
Three counter girls	8 (each)

Two extra girls, two hours per day at 16 cents per hour.

The more important machinery includes: One 10-foot gas range, one dish-washing machine, one potato-peeling machine, one bread-cutting machine, one meat-cutting machine.

Such a restaurant can serve at least 400 persons in five minutes.

Assisting Employees With the Army Questionnaire

ONE of the outstanding features of the war has been the enthusiastic coöperation of citizens and corporations in the performance of extra duties thrust upon them. Many of these have gone far beyond the requirements and assumed other duties in an endeavor to aid the Government.

The officials of the Westinghouse Electric & Manufacturing Company realized that after the new selective draft regulations went into effect, when all previous exemptions were automatically revoked and the registrants required to answer questionnaires, there was likely to be confusion among its employees as to just what course they should pursue, particularly in the case of those of foreign birth. The company employees in the Pittsburgh district number in the neighborhood of 35,000 people.

Frequent meetings of the officials and superintendents of the company were held to outline the plan for aid and insure the familiarity of those responsible for its execution with the draft regulations. Each superintendent then made up a list of men is his department subject to draft, checking those whose services were considered to be absolutely indispensable, and detailed a man to see that all registrants were properly classified within the time limit.

The company then sent a letter to each local board where any employees were registered, setting forth at some length the nature of its operations and how intimately its work was related to governmental activities, and how dependent it was upon skilled labor. The letter also stated that each case on which the company asked exemption would have been carefully considered and passed upon by the officials best qualified to know. In this way, the board was relieved of a lot of work in answering questions and had the assurance of responsible parties that the exemptions asked for were justified.

After the plan had been carefully outlined to those responsible for its execution, a set of rooms was set apart for the actual work of handling the registrants and their questionnaires. When it is realized that approximately 5,000 men were to be examined, and the short time allowed for its execution, the size of the undertaking can be appreciated.

As a large number of employees of foreign birth are unfamiliar with the English language 15 interpreters, capable of speaking almost any language or dialect in the civilized world, were secured and instructed in the provisions of the selective service regulations.

As each registrant received his questionnaire, he was sent to await his turn, as shown in Figure 1.

The registrant was given a card and assigned to one of the desks numbered from 1 to 15, see Figure 2. At each was located an interpreter to assist in answering the questions when such service was required. When the questions were all answered the registrant left the room by another door, and if the company had selected him for exemption, the questionnaire was retained by the clerk, sent to the superintendent of his section and then to the vice-president of the company for their supporting affidavits. After these are secured, it is returned for filing with the local board. If he was not considered absolutely essential by the company he was allowed to retain his questionnaire and return it to the local board himself.

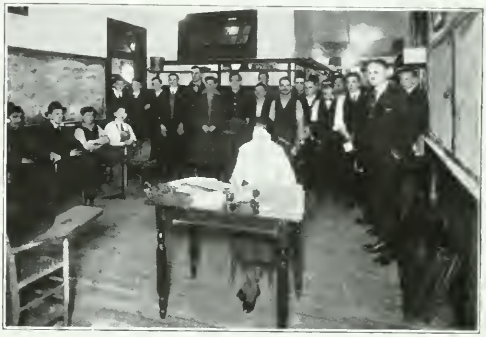


FIG. 1. AWAITING THEIR TURN TO ANSWER THE SELECTIVE QUESTIONNAIRE

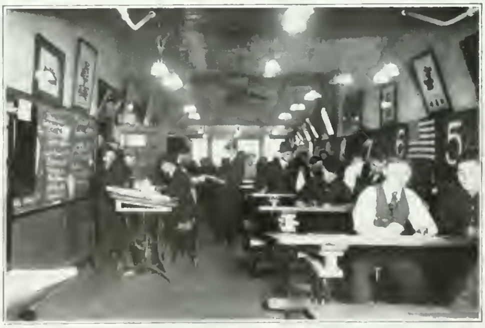


FIG. 2. ANSWERING THE QUESTIONS OF THE SELECTIVE DRAFT QUESTIONNAIRE

A notary public was retained by the company to save the expense of the notary's fee. Every employee was paid in full for all the time engaged in going through the process of completing the questionnaire.

The time required to take care of a registrant varied according to his intelligence and familiarity with the English language; some required only a few minutes, others considerably longer. The average time was about an hour per man.

As an evidence of the advantage accruing to the local boards from an arrangement such as outlined above, a Pittsburg board member said that only about 30 per cent. of the questionnaires turned in individually were correct, while under this plan practically all were right.

Editorials and Comment

Just Ahead

IS there to be a shortage of industrial employment in the Spring or early Summer?

The work of non-essential industry is slowing down. By "non-essential" is meant the manufacture of articles not needed for the prosecution of war, nor required for the essential welfare of our civilian population. Examples are: Jewelry, luxurious motor cars, silks, laces, pianos and perhaps talking machines.

If this process of slowing down industries of this kind continues we shall have a considerable portion of our labor turned out of its usual employment.

During the past month both the daily papers and the weekly reviews have begun to say that there is danger of a production of war material this year far greater than can possibly be shipped. This situation was commented upon in these columns in our February issue. If this process continues to such an extent that there becomes a congestion of war material in this country that cannot be sent to France, then workers on munitions and war supplies will have to be turned out of that kind of employment. There is one industry that can absorb perhaps 250,000 of them—shipbuilding. But to what work must the others turn?

The problems of transportation have never been brought to our people with more force than since the beginning of this year. Never before have we seen the holding back of industry in order that our railway lines might be cleared of accumulated freight. Never before have the difficulties of railroad operation in blizzards and zero weather been appreciated by those who are not railroad men or members of their families. Never before have we appreciated that the well-being, comfort and even life of our people rest upon the regular movement of freight over our great railway lines.

All of these experiences have shown us that we need more railroad equipment, locomotives, cars, terminals, dock facilities and the like.

The concentrating of industrial workers at new points of industry have brought to the forefront the problem of housing. Briefly stated we should have at once several hundred thousand more houses to shelter our working people.

The problem of handling freight has brought again to the fore the need of developing our canals and rivers as a part of the great transportation system of the country.

The shortage of coal for industrial uses has made more urgent than ever the need of haste in developing water-power projects to supply energy for the wheels of industry.

The shortening of our supplies of food, with the prospect of a tremendous demand upon us during the rest of the war and for a few years after the struggle ceases means that we must utilize more tillable land and turn our attention to reclaiming vast tracts which can be brought under cultivation.

That is, in addition to prosecuting the war we must constructively turn our attention to the up-building of railroad equipment, the housing of working people, the developing of our canals and rivers as a part of our transportation system, the utilization of water-power now running to waste, and the reclaiming of land for agriculture.

If in the Spring or early Summer thousands of industrial workers may be forced out of non-essential industries and even out of war industry, why should they not be put at work on some of these great national needs?

The improvement of our rivers, the digging of canals, the developing of our water-powers and the reclaiming of land have always been either entirely or to a great extent under government direction. Our railroads are now government operated and will continue to be so managed for the duration of the war and for eighteen months thereafter. In connection with war industries the government is making a careful study of housing and even supplying funds to solve the difficulties in certain centers where those industries predominate.

So no one can claim that these national needs should not be met by government action.

Is not the path of wisdom to adopt at once a policy to supply by the government much of the employment that our working people will need to earn their living when a stopping of the present lines of industry comes, either because of internal conditions or through the ending of the war?

Manufacturers' Associations

WE are beginning to see a new form of manufacturers' organization. About the middle of last summer the leather producing firms of the country united to assist in carrying on their industry during the period of war. The name adopted for the association was The Tanners' Council. Offices were opened in Washington with the president of the organization as general manager and a competent staff was gathered together.

Within the past few weeks the hardware interests have begun the formation of what is known as the Hardware Manufacturers' Association for War Service. At about the same time the founders also united in an organization for war work. The Tanners' Council, dealing with an industry tremendously affected by war conditions, has endeavored to inventory all of the raw material in this country for the production of leather, has been active in distributing orders between various plants, has assisted the government in obtaining deliveries, has aided in the preparing of reasonable specifications, and has been a medium for the bringing together of the various purchasing agencies of the government so that one would not gain control of all the material of a certain kind and grade to the exclusion of the needs of another. It has also assisted in the determination of prices.

The Hardware Manufacturers' organization presented in chart form shows a large number of divisions spread over the manufacturing of hardware, tools and general supplies made of metal, with an advisory price board and section committee heading each group or division. From a study of the literature put out by this organization the impression is given that at least one of the major ideas behind its founding is business conditions after the war. It seems reasonable to think that the organization found by the founders of the country has similar objects.

It is in order to say two things in this connection: The operation of the Sherman law has perhaps been suspended during war conditions but not as yet for the forthcoming days of peace. Too many manufacturers today are devoting themselves heart and soul to the making of profits, and only incidentally are helping to win the war as a sort of side issue.

Factory Gardens

A YEAR ago we were just entering the war. The increasing of our food supply was brought home to us as a popular war measure. The season was so well advanced that what was done to encourage factory gardening had to be done quickly. As might be expected all sorts of results were achieved.

Here and there were factories that handled the matter well, so that their employees raised a great deal of food, at the same time gaining in health, well being and furthering the development of the spirit of the organization of which they were a part. Here and there haphazard, ineffectual efforts brought little that was tangible. But the need for food during 1918 is going to be far greater than it was during 1917. Where one shop garden was essential last year perhaps five must be planted this. The difficulty of getting one or another common article for the home table, and the prevailing high prices, are all the proof that is needed to stimulate present gardening projects.

Two articles in this issue show satisfactory methods for factory gardening in two representative machine-tool plants of New England. In one case the workmen bought their own seed, paid for or rented their tools, and did all the work on their gardens. The land only was supplied, plowed and ready for cultivation.

The other plan was coöperative throughout, being managed by a so-called syndicate in which the employees bought shares.

In each case there was a satisfactory return for the labor and time expended, and plans are well under way to repeat the work this year. The example is well worth following.

And it must not be overlooked or minimized that the increase in the spirit of the organization is one of the best of the results of factory gardening.

Revivification in Industry

ON every side we are being told that the old days—good or bad—are gone never to return. It is being said that industry will be different, and employer and employee will emerge from this war each with a new viewpoint. But most that is being said and written applies only to material changes, to reconstruction or rehabilitation. These outgivings do not take into account the effect of the self-denial and sacrifice that men and women in American industry are giving as a part of their contribution to the preservation of this nation. Will there not come a revivification in industry as well as reconstruction and rehabilitation? A reader of INDUSTRIAL MANAGEMENT believes this and writes as one who is looking into the future.

"But the reconstruction period will be also a time of revivification! I seem to see more of coöperation and less of competition. I seem to see less of tense striving and more of stopping and looking about and enjoying of things as they are and always have been. I seem to see put in practice a bit of admirable advice which I once read somewhere to the effect that, 'As we journey through life let us live by the way.' I seem to see an earnest desire on the part of employers of labor to want their workmen to 'live by the way.' I seem to see less of grasping and more of giving.

"I seem to see Christ the Teacher returning into His Own. I seem to see the humanities more actively recognized and the sciences, as such, less seriously taken. I seem to see the spirit of friendliness and love, fellowship and brotherhood rise out of the dead ashes of this conflict, like a Phœnix, and flutter glad wings above a strained, drawn, haggard, muscle-bound, tired and soul-spent people—all kinds, all races, all creeds.

"I seem to see old enmities buried and new friendships made. I seem to see the seller voluntarily give the advantage, if there be any, to the buyer. I seem to see a rekindling of idealism, as it once was and so must be again, because life is a circle, and we are life. I seem to see honor and probity, charity and righteousness so common as to be beyond exaltation. I seem to see the power of money go down, and the things which it represents go the way of all other material things.

"I seem to see you and me, and our neighbor and our neighbor's neighbor, as one, a unit of life recognized as such, going shoulder to shoulder and elbow to elbow gladly along the way of peace, helpfulness and understanding to a goal the like of which never before was known in the history of the world.

"I seem to see all things in the days following the war—the days not only of reconstruction but revivification. God is Infinite in His Wisdom."

Standards of Unbalance

To know in an engineering sense we must measure. To evaluate the results of a manufacturing process we must count or weigh or gage, or in some way set what has been accomplished over against some previously established standard.

With the increase in the application of the process of dynamic balance of machine parts comes the need of measuring the degree of the results obtained, and the setting up of permissible limits to show successful practice. Now it is possible to weigh the amount of unbalance of a part that should be in either static or dynamic balance. The unit for static unbalance suggested by Mr. N. W. Akimoff is the *ounce-inch;* similarly the unit for dynamic unbalance is the *ounce—(inch)*^{2}. The limits suggested for commercial balancing on the ordinary run of high-speed machine parts are: For static unbalance not more than 0.4 ounce-inches; for dynamic unbalance not more than 12 ounce-(inches)^2.

Some such units and limits deserve to be widely adopted.

For nearly a year we have constantly seen efforts to recruit shipyard labor. Now the Shipping Board is taking a hand with the purpose of enrolling 250,000 men to be taken into the shipyards as needed.

What is the cause or reason for all these efforts? Surely there must be something deeper than the mere need of mechanics to build ships? The article on page 210 gives us the clue, when Mr. Kelly says that if excessive labor turnover in our shipyards is not checked it will be impossible to draw sufficient mechanics even from other industries to carry on the shipping program.

So the kernel of the trouble is that old industrial enemy "labor turnover."

Once he is recognized, steps can be taken to break down his destructive influence. And the article goes on to present some of the best methods that have already been adopted in leading yards.

Incidentally these same methods deserve to be studied by the managers of plants in other lines of industry, provided their labor turnover is not as low as it should be.

A reader of INDUSTRIAL MANAGEMENT has pointed out that we should not lose through the draft the men who are best fitted to teach in our trade and vocational schools, as they will be needed a little later to prepare unskilled men and women for industrial pursuits. He suggests that this viewpoint should be impressed upon the Federal Board for Vocational Education in Washington, in order that their influence may be thrown on the side of preventing a possible evil.

The difficulty of educating without an adequate teaching force cannot be appreciated by anyone who has not actually taught. The difficulties of training our army now in the cantonments is not understood except by those who have it in charge. England's situation in training her huge volunteer armies after she had lost her expeditionary force following the retreat from Mons was enough to stagger the force of will of even the strongest British statesmen.

In degree, of course, the training of the men and women who will come into our industry before very long is simpler than that of preparing a fighting army, but nevertheless it is of the utmost importance. Most thorough and careful consideration should be given to the claims of those that ask exemption on the grounds that they are engaged in teaching in our trade and vocational schools, and are thus in position to do excellent service in preparing the forthcoming industrial army for its duties.

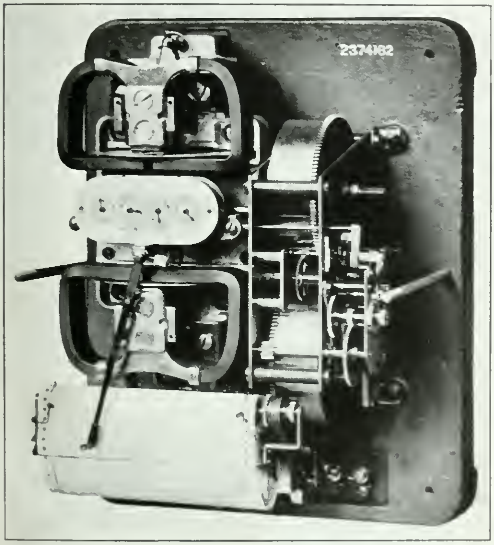
Factory Equipment News

The Latest Labor-Saving Machinery

Recording-Demand Watthour Meter

In large power requirements it is common to fix the rate of the service upon the time and duration of the occurrence of the maximum demand, as well as upon the amount of this demand. This service has brought the need for a demand meter to give a permanent graphic record. Such a meter is illustrated herewith and is a recent development of the Westinghouse Electric & Manufacturing Company, East Pittsbugh, Pennsylvania.

This instrument, known as type RA, in one unit measures both the kilowatt-hours consumed and the integrated demand. It indicates on a four-counter dial the total kilowatt-hours consumed and records on a graphic record the integrated demand under predetermined time intervals. The measuring and recording elements are mechanically inter-connected; there are no electrical contacts to become inoperative. The recording element is controlled by a high-grade clock. The measuring element is the standard Westinghouse type OA watthour meter with special gear train.



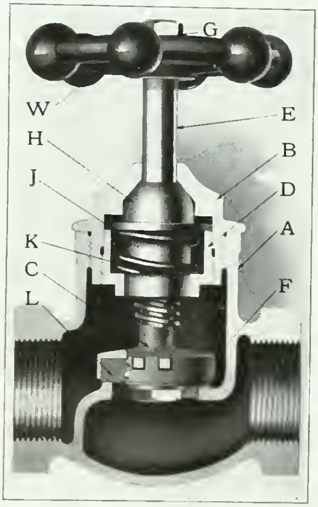
WESTINGHOUSE RECORDING-DEMAND METER

Sandusky Packless Valve

The feature of the globe valve illustrated below is the absence of all packing around the stem. It is one of the new line being manufactured and introduced by the Sandusky Packless Valve Company, Sandusky, Ohio.

In place of the usual packing nut or gland the stem, center piece and bonnet when in contact form a ground joint between the rounding or hemispherical surface of the center piece and the inside tapered surface of the bonnet. A helical spring around the stem presses against the lower flange of the center piece holding this ground joint tight. The nut containing the spring serves to hold the lower end of the stem central with the body of the valve, and also comes in contact with the flange of the center piece so that the ground joint remains tight regardless of the downward or side pressure of the hand-wheel.

The lower end of the stem has a double left-hand Acme thread. The opening and closing of the valve is done by the threaded stem of the disc holder which fits in the lower end of the stem. Guides on the disc holder engage another guide on each side of the body preventing the disc holder from turning when the hand wheel is turned so that the two threads must function and raise the disc from the seat. The disc is held in place in the holder by means of a lock nut so that it can be renewed if necessary without removing the valve from the pipe line.

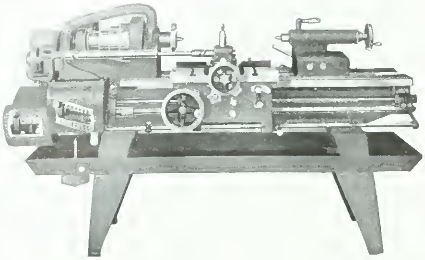


SANDUSKY PACKLESS VALVE

15-inch Crawford Lathe

The latest model of the Crawford lathe manufactured by the Joseph Crawford, Jr., Company, Erie, Pennsylvania, is shown in the accompanying illustration. Listed as a 15 inch lathe it swings over the ways 16½ inches; over the carriage 9½ inches; the maximum distance between centers is 34 inches; the back gear ratio is 8½ to 1, and the gear box is arranged to cut threads from 2 to 210 per inch. The centers are Morse taper No. 3, and the spindle sleeve is Morse taper No. 5.

The general features of construction follow well established design. The hollow spindle is made from a carbon-steel forging finished and ground; the bearings are bronze bushed; both the longitudinal and cross feeds are friction driven and can be quickly thrown in or out. The cross feed screw is provided with micrometer adjustment.



NEW CRAWFORD LATHE

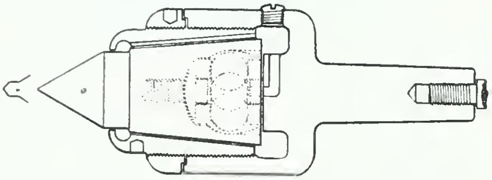
For cutting threads the lead screw is used and by shifting the position of the two handles on the feed box 48 different speeds for threading and feeding can be obtained. A separate rod is provided for the feeding mechanism.

The lathe can be provided with a taper turning attachment, and a spiral relieving attachment to do both inside and outside relieving on either right-hand or left-hand work or any number of flutes from 2 to 28 inclusive. Four cams are furnished, each arranged to relieve 3/32 inch in depth.

The regular equipment includes a double friction countershaft, two face plates, steady and follow rests and wrenches.

Ballbearing Lathe Center

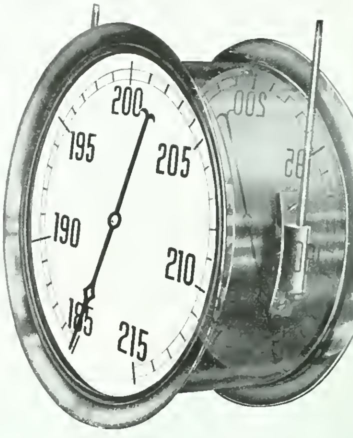
THE ballbearing lathe center shown herewith has been developed for the use of metal spinners and wood turners. The central revolving stem is large to give radial end support. It has a floating tri-thrust ballbearing. A stem cap or bearing is provided with oil channels and drip retainer, and is adjustable in the housing by means of a lock ring. The oil chamber is connected with both stem and ballbearing. The shank is in one piece with the housing, and supplied with an extension rod for knock-out. This tool is manufactured by J. A. Moller of New Rochelle, N. Y.



Master Pressure Gages

TWO master pressure gages have recently been placed on the market by the Ashton Valve Company, Boston, Mass. One of these, the master pilot pressure gage, is shown herewith.

The other type, known as the Standard master pressure gage, is intended for use in large power plants where it is desirable to have a gage that can be readily from any location, and wherefrom the steam pressure can be easily read. When installed at one end of a boiler or engine room the single dial style is used, but if the location is at the center of the room the double dial style is preferable. To provide for poorly lighted applications, or night service, these gages are made with a specially illuminated dial of opal glass so arranged that electric lamps can be inserted inside of the gage thus illuminating the back of the dial, and making it possible to see the indicating hand and graduations at all times.

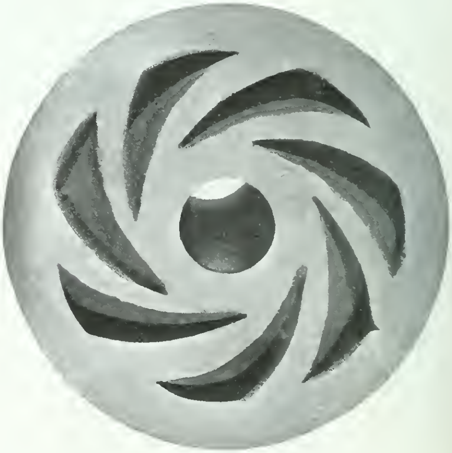


ASHTON MASTER PRESSURE GAGE

The master pilot pressure gage illustrated differs from the standard master gage by having a dial graduated to show only a pressure scale such as is used in the ordinary range of working purposes.

A Turbo Pump Valve

THE principle behind the Worden pump valve is that wear is prevented for the valve will never seat successively twice in the same place. Several pockets, as shown in the illustration cause the valve to rotate. One side of each pocket is at an acute angle and the other is square with the face. The action of the liquid as it rises upward through the valve seat is to strike the square side of the pocket and cause the valve to turn.



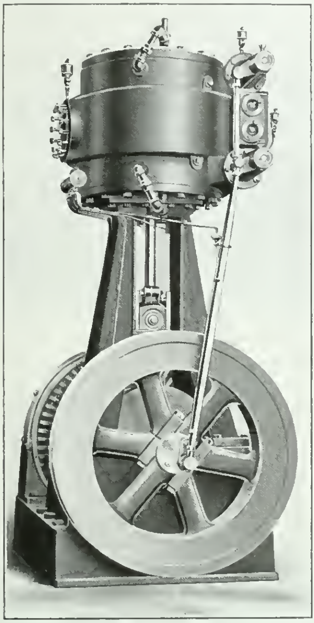
TURBO PUMP VALVE

This action of the valve whereby it does not seat twice in the same place successively tends to bring about a minimum of wear and a condition that is self-cleaning.

The valve is a product of the John-Roger Company, Coopersville, Mich.

Vertical Rotative Dry Vacuum Pump

TO meet the demand of shipbuilders and the designers of power plants who are anxious to save as much space as possible a vertical type of dry vacuum pump has been brought out by the Wheeler Condenser & Engineering Company of Carteret, N. J., and is illustrated herewith. Where much condensing is to be done and where high vacuum must be maintained a motor or turbine-driven centrifugal pump can easily take care of the condensate while the pump shown withdraws the air. As the illustration shows the inlet valves of this pump are of the semi-rotative type and are so manipulated by the valve gear as to draw air from the condenser during full stroke. Clearance difficulties are eliminated by providing ports which register with an equalizing passage. The valves are of the poppet type and are easily accessible. The valve arrangement is such as to give perfect drainage at all times.

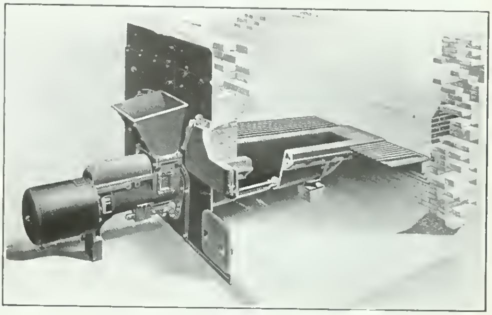


VERTICAL TYPE DRY VACUUM PUMP

Moloch Underfeed Stoker

A STOKER constructed along established lines embodying the principle of underfeed firing, in which the coal is brought from beneath and pushed up through the distillation and coking zone of the fire, is illustrated in Figures 1 and 2. Of these, the first illustration shows a general view of the completed stoker as applied to boilers and furnaces for industrial purposes. Figure 2 is a sectional view through the cylinder and operating mechanism. This stoker is a product of the Moloch Stoker Company, Chicago, Illinois.

Important features of its design are the mechanical arrangement of its parts and the operation of the timing device developed with the purpose of decreasing the amount of steam necessary actually to operate the stoker itself. The main cylinder is lagged and jacketed to reduce condensation. The cylinder and all parts connected with it, including the ram and pusher rod, can be removed from the ram case by unbolting the cylinder and pulling the mechanism through the ram case. This can be done without disconnecting any of the steam pipes.



MOLOCH UNDERFEED STOKER

Side plates provided below the hopper can be taken off and obstructions removed from in front of the ram, should any be found. This can be done without removing the coal from the hopper or the hopper itself.

The retort is made in sections to prevent cracking of the main body. As the upper parts holding the tuyere block are sectional they are easily removed. The dead plates are made in sections to prevent warping.

Referring to Figure 2, it will be seen that the main operating valve, placed on the ram case, consists of two steam thrown valves in one casing, each set of pistons taking care of its respective end of the cylinder. The pistons are held in position by means of an overbalancing area of the larger against the smaller.

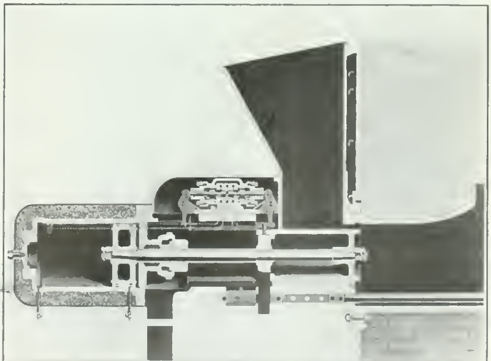


FIG. 2. SECTION OF STOKER MECHANISM

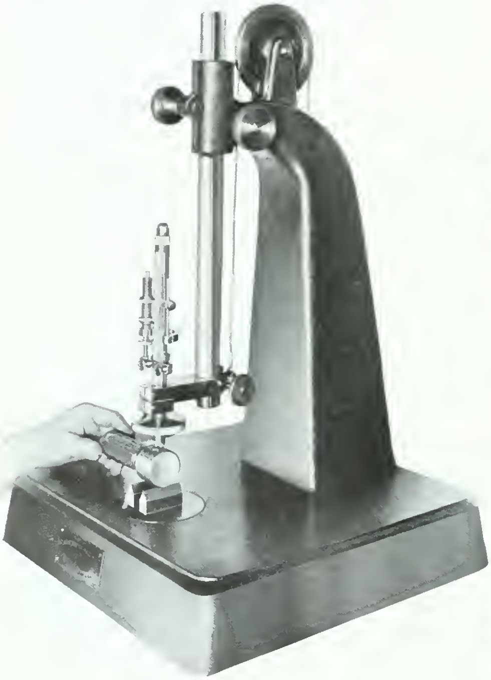
In the position of the ram as shown in Figure 2, to make an operating cycle the chamber of the operating valve nearest the cylinder end is thrown open to exhaust by the timer valve thus relieving the pressure of the large piston at that end and causing the pressure of the two smaller pistons to drive the valve forward until the small piston passes the stoker port, thus connecting this with the main steam chamber in the cylinder. This action drives the ram back, and when it comes practically to the end of its stroke the pin on the ram case engages with the lever and the motion of the ram causes the main valve to be pushed back to its seat thus cutting off the steam supply to the main cylinder. The exhaust from the timer valve is then shut off and steam at boiler pressure again admitted in the chamber of the larger piston thus holding this valve in its normal position without the aid of the pin on the arm.

The same operation then takes place with the other end of the pistons of the main operating valve, thus bringing the ram back into the position shown in the illustration when the machine is ready for the next cycle.

Eight gradations of speed are available from zero to maximum. These are all obtained by moving the handle of the timing device to various holes corresponding with the speeds desired. The main shaft of the timer mechanism is so arranged that by using an ordinary monkey wrench the timer valve can be operated by hand without throwing the mechanism into operation.

Thread Gage Testing Machine

A COMPARATOR for the comparison of working thread gage and master thread gage has been developed by the Coats Machine Tool Company, Inc., New York City, by applying a Prestwich fluid gage to a Wilhelm pitch diameter comparator. This instrument may also be used for establishing the value of a master gage by using it in combination with swedish gages or other verified standard blocks. The machine consists of a base carrying an upright overhanging standard or column. In the base is set a true lapped steel plate, which is set square with a hole through the standard in which slides a bar carrying the supper measuring points in the form of a double roll. These measuring points rest on both walls of the upper part of the thread to be measured.


THREAD GAGE TESTING MACHINE

Underneath the thread gage that is being measured are five-sided parallel blocks made with the same degree of accuracy as standard space blocks, the two upper surfaces coming together at an angle equalling the angle of the thread to be measured. These blocks are set on the lapped steel base plate at the base of the instrument and the gage rests upon them.

Accuracy of reading is obtained by use of a Prestwich fluid gage. The upper thread measuring roll is carried on the lower end of a vertically slidable spindle. The upper end of the spindle rests on the upper part of the diaphragm of the fluid gage, and in this way gives a reading on the gage column.

After a thread gage has been measured, if a second one is inserted into the instrument and is of the same size the fluid gage will give the same reading. If the second thread gage is larger the fluid gage reading will be higher than before, and if it is smaller the indicating column of the fluid gage will not rise as high as before.

The instrument has a capacity for all thread gages from ¼ to 10 inches in diameter. This large size comparator has been developed for the use of the United States Government in the manufacture of munitions. A similar instrument for the same purpose having a smaller ranger is also manufactured.

48-inch Relief Valve

THE accompanying illustration shows a horizontal exhaust relief valve recently made by the G. M. Davis Regulator Company, Chicago, Illinois. It is to be used as a safety release for the condenser on a new turbine unit. It has a valve disc 48 inches in diameter; it measures 7 feet 5 inches face to face of the flanges and weighs 4000 pounds. The valve disc has a bearing metal face, which seats on a brass ring. The valve is water sealed and is double cushioned with brass-lined dash pots above and below the disc. The valve stem is 3½ inches in diameter.

DAVIS 48-INCH RELIEF VALVE

New Britain Automatics

FIGURE 1 illustrates size 3, New Britain multiple spindle chucking machine, work-revolving type.

This machine although designed to handle much the same variety of work as regular single-head automatic chucking machines has two points of difference; namely, (a) the work is held and revolved by the spindles, the tools being fixed in the tool slide; (b) the use of cross-slide tools is rendered possible, a feature lacking in the type where the work is held stationary. The machine has six spindles of hammer forged, heat treated, hardened and ground chrome-nickel steel. The spindle bearings are of bronze, ground straight inside and tapered outside. To retain the original accuracy of the machine provision is made for taking up wear in the bearings without disturbing their alignment; ball thrust collars are provided on the spindles to take the end thrust of the cutting tools; change gears provide five rates of spindle speeds and twelve variations of food.

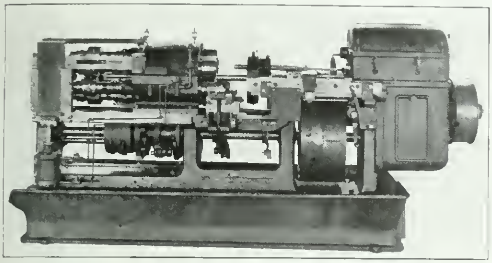


FIG. 1. MULTIPLE SPINDLE CHUCKING MACHINE

The base of the machine forming the chip pan extends to the floor without legs. That portion of the bed directly beneath the work has a 45 degree incline toward the back so that chips are at once carried to the side. At this point the chip pan is widest and slopes toward the rear where is located a strainer and oil well from which oil is taken for distribution to the work. The whole distributing system is designed to avoid as much external piping as possible. This is accomplished by conveying the oil through the inside of the tool-slide into a chamber surrounding the driving shaft bushing, from this point it is tapped off at the circumference through short tubes to the individual tools. The oil pump is driven at constant speed.

Hand control levers in easy reach of the operator enable the power feed to be instantly started or stopped. A hand-feed crank is provided for testing all feed movements and tool positions. To insure protection to the operator, the spindle is automatically disconnected from the drive during loading and unloading of the chucks.

The indexing mechanism is patterned after the Geneva stop motion; the differential motion index is regularly fitted to this machine and indexes the spindle cylinder and operates the tool-slide at high speed when the tools have finished cutting; special draw-in spring collets are employed which operate satisfactorily where pieces do not show a variation exceeding 1/32 inch in diameter; if desired the machine may be equipped with a special air-chucking attachment; a threading attachment may be installed in fourth tool slide position; the tool slide cam is laminated similar to a leaf spring, this permits of adjustment of one cam to all lengths of work within the capacity of the machine.

As the direction of rotation of spindle is right-handed, standard tools, drills, reamers, etc., are used.

Figure 2 shows another new automatic, the New Britain sextuple automatic bar machine for such work as blanking rolls, sleeves, couplings, and the like.

In many respects this six-spindle automatic machine is similar in construction to the New Britain six-spindle automatic machine described above. However, the cylinder spindle does not index as the machine is designed to feed, drill, chamfer and cut off in each position. On simple work this makes possible production from six spindles instead of from one as on single-spindle machines.

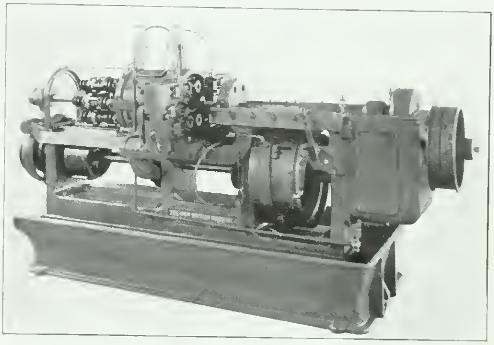


FIG. 2. SEXTUPLE AUTOMATIC BAR MACHINE

The general features of the spindles, spindle bearings and ball thrusts are the same as on the machine previously described. The change gears provide six rates of spindle speeds and a separate system of change gears is provided for effecting changes in feed by varying the speed of the cam shaft.

The differential motion, tool-slide, tool-slide cam, base, oil distributing system and hand control levers are the same in this design as in the machine first described.

Standard drills are used as the direction of the spindle rotation is right handed. The machine may be equipped for either single belt or motor drive.

Both of these machines are recent products of the New Britain Machine Company, New Britain, Connecticut.

"Wisconsin" Universal Grinder

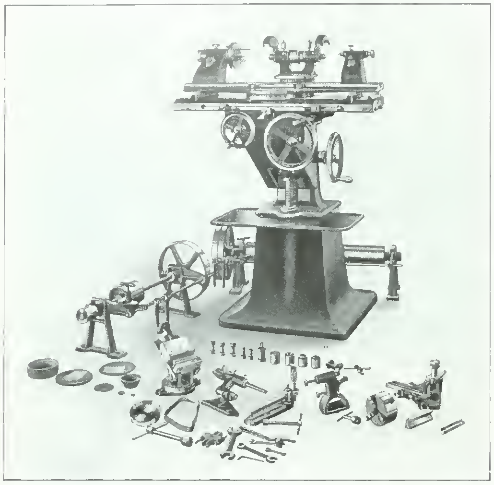
THE Wisconsin universal grinder has been designed to handle all kinds of tool and cutter grinding, as well as cylindrical, internal and surface grinding within the limits of its capacity.

The base of the machine is 24 inches square at the bottom, with a door at the back to give access to shelf space for the storage of tools and fixtures. The column is of a box section, carrying the vertical slide for the knee and supporting in a flange, as shown, the bronze nut for the knee elevating screw. Wheel spindle head is attached directly to upper end of the column.

The knee is of a box section entirely enclosed, except for the opening for the elevating screw. On one side is a tee slot carrying the stops for the cross feed. The saddle is substantially ribbed and fitted to the knee with a long bearing.

The table is supported on a sub-table giving a cylindrical bearing at the center and supporting pads at the ends. This table can swivel 90 degrees each way, and is graduated both in degrees at the center and for tapers per foot.

The table surface is 5 inches wide by 36 inches long; the longitudinal table movement 20 inches; transverse table movement 8 inches; vertical table movement 9 inches; swing of centers 10 inches in diameter; the internal grinding attachment grinds holes 9/16 inch diameter and larger, by 4 inches deep.

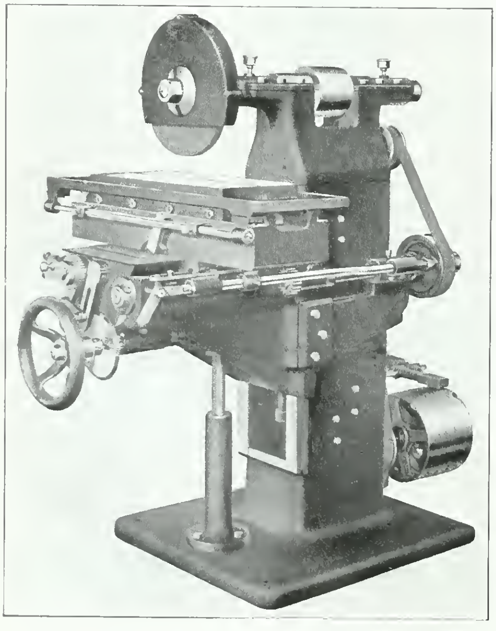


UNIVERSAL GRINDER

This machine is manufactured by the Dauber-Kratsch Co., Oshkosh, Wisconsin.

No. 2 Surface Grinder

AN automatic surface grinder of the knee-and-column type manufactured by the Noble & Westbrook Manufacturing Company of Hartford, Connecticut, is herewith shown.



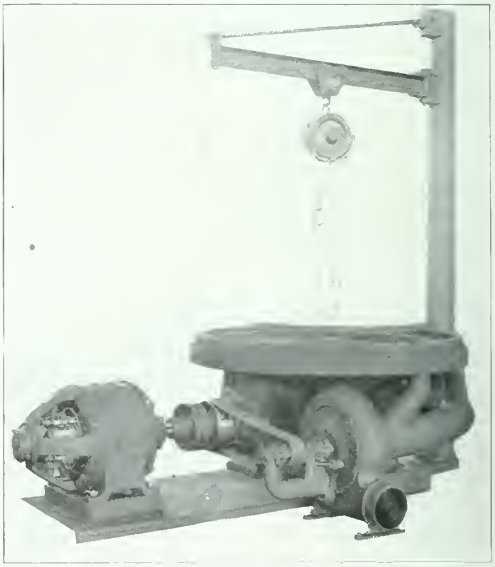
NO. 2. SURFACE GRINDER

The general features of construction follow standard design. Care has been made to protect all working parts from dust. The mechanism for raising and lowering the table is provided with ball thrust bearings; micrometer dials control the movement of the feeds. The spindle is made of crucible steel, and all slides and the spindle have take-up bearings. The cross slide is equipped with an automatic stop as a safeguard and the platen can be started or stopped instantly by using the hand lever and without stopping the spindle or other parts of the machine.

The working surface of the table is 8 x 20 inches in size; distance from the center of the spindle to the top of the table 13½ inches, the spindle flanges are adapted

Vertical Disk Grinding Machine

A VERTICAL disk grinding machine embodying the features of a self-contained hoisting attachment for handling heavy work, a dust exhaust system, and means for adapting the machine for direct motor drive, has recently been brought out by the Gardner Machine Company, Beloit, Wisconsin. The accompanying illustration shows these general features.



The machine is equipped with a disk wheel 53 inches in diameter designed for heavy grinding. This wheel is supported by a cast-iron flange 20 inches in diameter and 1⅜ inches thick, supported on the upper end of a vertical spindle 3⅝ inches in diameter. This spindle is driven by a pair of hardened steel bevel gears. The spindle thrust is taken on self-aligning radial ball bearings. The hoisting attachment consists of a ¼-ton, hand-operated chain hoist mounted on a trolley and swinging jib. The supporting column is rigidly attached.

The dust exhaust system includes a belt driven fan whose suction manifold is connected through four openings with the bottom of a dust channel cast into the base of the machine, around and just below the edge of the wheel. A detachable guard ring permits the removal of coarse particles.

Personal and Business Items

In its bulletin entitled "Fundamentals of Illumination Design," the Engineering Department of the National Lamp Works of the General Electric Company has presented in simple and readable language a discussion of the broad principles which underlie illuminating engineering practice. It is a bulletin which should prove of value to schools and colleges, but its usefulness is not limited to students, however, for much of the material presented is the result of recent investigations, and the data will bear the closets scrutiny of the practicing illuminating engineers. Industrial lighting, light projection, protective lighting, etc., are taken up.

* * *

Mr. Guy E. Tripp, of New York, Chairman of the Westinghouse Electric and Manufacturing Company, has been appointed chief of the Production Division of the Ordnance Bureau of the War Department. He is entrusted with the task of supervising and stimulating the production of all ordnance material and supplies. He has been given a commission with the rank of Colonel.

* * *

Ford, Bacon & Davis, Engineers, New York, N. Y., announce the formation of the Ford, Bacon & Davis Corporation, organized for the purpose of conducting a general contracting business, with particular reference to industrial, public utility and power plants, steam and street railroads, docks, steamship and railway terminal facilities, subways, tunnels, hydro-electric and irrigation projects. In effect this means the continuance in corporate form of construction work which heretofore has been handled by the firm direct.

* * *

Mr. John D. Stout has been appointed Chicago representative for the Terry Steam Turbine Company of Hartford, Conn. Mr. Stout was at one time Assistant Engineer of the Terry Steam Turbine Company, and was recently transferred from the New York office where he was Assistant Manager.

* * *

The Cleveland Automatic Machine Tool Company, of Cleveland, Ohio, has recently published for complimentary distribution an attractive booklet entitled "31 Articles by J. P. Brophy." A sub-title states that these deal with mechanical information, municipal problems, political problems, human qualities, humor, war and general business administration. Most of them have been published from time to time in the technical and trade papers. Mr. Brophy's writings always attract attention for he is a man of conviction and writes what he believes. Many of his comments run counter to opinions freely expressed in business circles; as for instance, his skepticism as to the era of large business immediately after the close of the war. All of these opinions are backed up by facts and at once command attention. Any industrial manager will find that it is well worth-while to read this little book.

* * *

Mr. J. H. Pardee, President of the J. G. White Management Corporation, New York, and Mr. J. P. Ripley, Engineer, have returned to New York from a general inspection of the Manila Electric Railroad & Light Company, and other interests in the Philippine Islands operated by The J. G. White Management Corporation.

* * *

Technical information regarding Bakelite Micarta-D Gears is contained in a twelve-page pamphlet recently published by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa. The distinctive features of this material for noiseless gears and pinions are listed together with its physical properties. Methods of turning and drilling and gear cutting are described and illustrated with halftones and drawings. Methods of attaching to the driving shaft which have proved suitable for gears of all sizes are shown, and tables of pitch, teeth and other gear data are also given. There are formulas for horsepower rating, the amount of power which can be transmitted through press fits and for calculating other variables in gear practice.

* * *

An attractive catalog of grinding and polishing machinery has just been issued by the Gardner Machine Company, Beloit, Wis. In addition to illustrating, describing and giving general information in regard to their line of grinding machines, accessories and supplies, there are several pages of general information in regard to the use of abrasive disks. The catalog is attractively printed, containing 115 pages.

* * *

Mr. George L. Hedges has resigned his position with the Kelman Electric & Manufacturing Company, of Los Angeles, Cal., to report at Washington, D. C., for active duty as First Lieutenant in the Officer's Reserve Corps, Ordnance Department.

* * *

The Griscom-Russell Company, New York City, N. Y., have just published a small folder illustrating and briefly describing their line of power plant equipment which includes feed water heaters, oil heaters, oil coolers, evaporators, expansion joints, grease extractors, steam and oil separators and Russell steam engines.

* * *

Catalogue 8-E has just been issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Penn., describing all of the industrial electric heating apparatus manufactured by that firm. The line includes steel clad heaters for many industrial processes, immersion type water heaters, stoves or various forms, chocolate warmers, tailors' irons and electric oven heaters for use in enameling.

* * *

Mr. E. F. Lake, metallurgical engineer, has taken the position of assistant superintendent of the Rich Tool Company, Chicago, Illinois. The company is manufacturing one piece valves from high speed steel for airplane and automobile engines.

* * *

The Hoppes Manufacturing Company, Springfield, Ohio, announces the recent appointment of Mr. W. R. Jennison as their Southeastern representative. He will handle the entire line of the firm's products in that district with headquarters at 407 Bisbee Building, Jacksonville, Florida.

* * *

At the annual meeting of the Engineering Society of York, Penn., held recently, the following officers were elected for the ensuing year: President, James Rudisill; Vice-President, Chauncey D. Bond; Secretary, M. Haller Frey, Polack Building; Treasurer, Harold A Russell; Directors: George A. Jessop, Charles L. Berger and Howard J. Longenecker.

* * *

The Western Efficiency Society has elected the following officers for 1918: President, F. A. Carlisle; First Vice-President, S. E. Stout; Second Vice-President, J. R. Shea; Secretary and Treasurer, George C. Dent.

EXPLANATORY NOTE—THE ENGINEERING INDEX

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cents. A denotes a price of 40 cents; B, 60 cents; C, 80 cents; D, $1.00; E, $1.20; F, $1.60. The letter N indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

Serial publications are indexed on the appearance of the first installment.

CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of INDUSTRIAL MANAGEMENT at 10 cents per month, or $1.00 a year; to non-subscribers, 25 cents per month, or $3.00 a year.

REFERENCE LIST OF PUBLICATIONS REGULARLY REVIEWED AND INDEXED

ARRANGED IN ORDER OF THEIR ABBREVIATIONS

A A Wkly	Aerial Age Weekly
AERA	AERA
Aeronts	Aeronautics
A I C E	Amer. Institute of Chemical Engineers
A I E E	Amer. Institute of Electrical Engineers
A I M E	Amer. Institute of Mining Engineers
A I Mt	Amer. Institute of Metals
Am Ec Rev	Amer. Economic Review
Am El-Chem Soc	Amer. Electro-Chemical Society
Am Fdymns Assn	Amer. Foundrymen's Association
Am Ir & Stl Inst	Amer. Iron & Steel Institute
Am Jl Pub Hh	Amer. Journal of Public Health
Am Jl Sci	Amer. Journal of Science
Am Mach	Amer. Machinist
Am Rd Blds Assn	Amer. Road Builders' Association
Am Ry Bdge & Bldg Assn	Amer. Railway Bridge & Building Association
Am Soc Ht & Vt Engrs	Amer. Society of Heat. & Vent. Engrs.
Am Soc Mar Dftn	Amer. Society of Marine Draftsmen
Am Soc Nav Engrs	Amer. Society of Naval Engineers
Am Soc Ref Engrs	Amer. Society of Refrig. Engineers
Am Soc Tes Mat	Amer. Society of Testing Materials
Am Wd Pres Assn	Amer. Wood Preserv. Association
Am Wr Wks Assn	Amer. Water Works Association
A R E A	Amer. Railway Engineering Association
A R M M A	Amer. Raliway Mas. Mech. Assn.
Arch For	Architectural Forum
Arch Rec	Architectural Record
A S C E	Amer. Society of Civil Engineers
A S M E	Amer. Society of Mechanical Engineers
Assn Eng Soc	Association of Engineering Societies
Assn I S E E	Association of Iron & Steel Elec. Engrs.
Aus Min Stan	Australian Mining Standard
Auto	Automobile
Autocar	Autocar
Bkn Engs Cb	Brooklyn Engineers' Club
Bos Soc C E	Boston Society of Civil Engineers
Br Rds & Sts	Better Roads and Streets
Brs Wld	Brass World
Bt Fe & Stl Pt	Blast Furnace & Steel Plant
Can Engr	Canadian Engineer
Can Min Jl	Canadian Mining Journal
Can Soc C. E.	Canadian Society of Civil Engineers
Cas Eng Mthly	Cassier's Engineering Monthly
Cen Ry Cb	Central Railway Club
Chem Eng & Min Rev	Chemical Engineering and Mining Review
C E Soc St P	Civil Engineers Society of St. Paul
Cl Age	Coal Age
Colly Gdn	Colliery Guardian
Col Sl Min Mag	Colorado School of Mines Magazine
Col Univ Qly	Columbia University Quarterly
Com Air Mag	Compressed Air Magazine
Com Vhle	Commercial Vehicle
Comwlh Engr	Commonwealth Engineer
Concte	Concrete
Contg	Contracting
Contr	Contractor
Corn C E	Cornell Civil Engineer
Cr Min West Aust	Chamber of Mines of West Australia
E Cb Balt	Engineers' Club of Baltimore
E Cb Phila	Engineers' Club of Philadelphia
E Cb St L	Engineers' Club of St. Louis
Econ Geol	Economic Geology
Eff Soc Jl	Efficiency Society Journal
Elec Jl	Electric Journal
Elec'n	Electrician
Elec Rev	Electrical Review
Elec Rev Chi	Electrical Review, Chicago
Elec Ry Jl	Electric Railway Journal
Elec Wld	Electrical World
Eng & Con	Engineering and Contracting
Eng & Min Jl	Engineering and Mining Journal
Eng Ed	Engineering Education
Eng News Rec	Engineering News-Record
Engng	Engineering
Engr	Engineer
Eng Rv	Engineering Review
Engr Soc Penn	Engineers Society of Pennsylvania
Fkn Inst Jl	Franklin Institute Journal
Flying	Flying
Fndry	Foundry
Gen Elec Rev	General Electric Review
Ht & Vtg Mag	Heating and Ventilating Magazine
Ice & Refrig	Ice & Refrigeration
Ill Eng Soc	Illuminating Engineering Society
Imp Inst Bul	Bulletin of the Imperial Institute
Ind Man	Industrial Management
InstAut Engrs	Institute of Automobile Engineers
Inst Rad Engrs	Institute of Radio Engineers
Inst San Engrs	Institute of Sanitary Engineers
Instn C E	Institution of Civil Engineers
Instn E E	Institution of Electrical Engineers
Instn E & S Scot	Inst. of Engrs. & Shpbldrs. of Scot.
Instn Mun & Cnty Engrs	Inst. of Munic. & County Engrs.
Instn Mech Engrs	Institution of Mechanical Engineers
Inst Met	Journal of the Institute of Metals
Instn Min Engrs	Institution of Mining Engineers
Instn Min & Met	Institution of Mining & Metallurgy
Int Mar Eng	International Marine Engineering
Iron Age	Iron Age
Ir & Cl Trds Rev	Iron & Coal Trades Review
Iron Trd Rev	Iron Trade Review
Jl Actcy	Journal of Accountancy
Jl Geol	Journal of Geology
Jl Ind & Eng Chem	Journal of Indust. & Eng. Chemistry
La Eng Soc	Louisiana Engineering Society
La Nat	La Nature
L S Min Inst	Lake Superior Mining Institute
Machy	Machinery
Manr Assn Engs	Manchester Assn. of Engineers
Mfrs Rec	Manufacturers' Record
Mar Eng & Nav Arch	Marine Engineer & Naval Architect
Mar Rev	Marine Review
Mas Boil Mkrs Assn	Master Boiler Makers' Association
M C B A	Master Car Builders' Association
Mech Eng	Mechanical Engineering
Mech Wld	Mechanical World
Met & Chem Eng	Metallurgical & Chemical Engineering
Min Mag	Mining Magazine
Min & Met Soc Am	Mining & Metallurgical Soc. of Amer.
Min & Sci Pr	Mining & Scientific Press
Mun Eng	Municipal Engineering
Mun Engrs Jl	Municipal Engineers' Journal
Mun Jl	Municipal Journal
Nat Assn Corp Schls	National Assn. of Corporation Schools
Nat Engr	National Engineer
Nat Lime Mfrs Assn	National Lime Manufacturers' Association
Nature	Nature
N E C Instn	N-E Coast Institution
N E Rd Cb	New England Railroad Club
N E Wr Wks Assn	New England Water Works Assn.
N Y Dept Labor	New York State Dept. of Labor
N Y Rd Cb	New York Railroad Club
Per-Way Instn	Permanent-Way Institution
Phil Jl Sci	Philippine Journal of Science
Power	Power
Pwr Pt Eng	Power Plant Engineering
Prof Mem	Professional Memoirs
Quarry	Quarry
Roy Un Ser Instn	Royal United Service Institution
Ry Age Gaz	Railway Age Gazette
Ry Cb Pitts	Railway Club of Pittsburgh
Ry Engr	Railway Engineer
Ry Gaz	Railway Gazette
Ry & Loco Eng	Railway & Locomotive Engineering
Ry Mech Engr	Railway Mechanical Engineer
Ry Rev	Railway Review
Ry Sig Engr	Railway Signal Engineer
S A E	Society of Automobile Engineers
Schl Min Qly	School of Mines Quarterly
Sfty Eng	Safety Engineering
Sib Jl Eng	Sibley Journal of Engineering
So Af Inst Engrs	South African Instn. of Engineers
Soc Nav Arch & Mar Engr	Society of Naval Arch. & Mar. Engrs.
Soc Pro Sci Man	Soc. to Promote Sci. of Management
S & S W Ry Cb	Southern & Southwestern Railway Club
St L Ry Cb	St. Louis Railway Club
Stev Indic	Stevens Indicator
Stl & Iron	Steel & Iron
Surv'r	Surveyor & Municip. & County Engr.
Tel Engr	Telephone Engineer
Telephony	Telephony
Times Eng Supp	Times Engineering Supplement
Tmwy & Ry Wld	Tramway & Railway World
Univ Col Jl Eng	Univ. Colo. Journal of Engineering
Univ Ill	University of Illinois
Univ Kan	University of Kansas
Univ Minn	University of Minnesota
Univ Mo	University of Missouri
U S Bur Mines	U. S. Bureau of Mines
U S Bur Stds	U. S. Bureau of Standards
U S Dept Ag	U. S. Dept. of Agriculture
U S Geol Surv	U. S. Geological Survey
U S Nat Inst	U. S. Naval Institute
West Eng	Western Engineering
West Ry Cb	Western Railway Club
West Scot I & S Inst	West. Scotland Iron & Steel Inst.
West Soc Engrs	Western Society of Engineers
Wis Engr	Wisconsin Engineer
Worc Poly Inst Jl	Worcester Polytechnic Inst. Journal

The Engineering Index

The following pages form a *descriptive* index of the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world in the English, French, Dutch, Italian and Spanish languages, as far as possible on account of war.

The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the charter and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us. See the Explanatory Note given on the opposite page, where also the full titles of the principal journals indexed are given. This list is subject to change from time to time.

NOTE.—The Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

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INDUSTRIAL MANAGEMENT

EDUCATION

Agriculture

L'Importance Économique De L'Enseignement Agricole (83929 C). H. M. Nagant. 4500 w. Revue Trimestrielle Canadienne—Nov., 1917. Economic importance of the study of agriculture.

Apprentices

Apprenticeship Training—Including an Account of a Possible System of Continued Education for Engineering Apprentices (83840 N). A. P. M. Fleming. 34 pp. Instn E & S Scot, Trans—Dec., 1917. Principles and basic requirements.

The Training of Engineering Apprentices (83383 A). Addresses by A. E. Carter and by R. W. Bailey. (Slightly abridged.) 8000 w. Engng—Dec. 14, 1917. Recommendations of educators.

Apprenticeship

Improved Apprenticeship Methods on the Pennsylvania (83728). J. H. Yoder. Ills. 2000 w. Ry Mech Engr—Jan., 1918. Latest developments in the course.

Chemistry

L'Avenir De L'Industrie Chimique En France (83938 B). A. Kling. 4000 w. Le Génie Civil—Nov. 24, 1917. Future of industrial chemistry in France.

La Chimie Industrielle (83930 C). L. Bourgoin and P. Le Cointe. 4000 w. Revue Trimestrielle Canadienne—Nov., 1917. Introductory lecture of a new course.

Craftsmen

The Education of Skilled Craftsmen (83695 A). C. A. Otto. 1000 w. Mech Wld—Jan. 4, 1918. Suggestions.

Crippled Soldiers

The Engineer, the Cripple and the New Education (83335 A). Frank B. Gilbreth and L. M. Gilbreth, with discussion. 7000 w A S M E, Jl—Jan., 1918. Reviews progress in the solution of the problem of training cripples.

Efficiency

Under New Management—A Man's Power (83948 A). Charles M. Horton. 3000 w. Ind Man—Feb., 1918. Possibilities of man's achievements.

Engineering Instruction

Special Education in Time of War (83327 A). Charles S. Howe. 2500 w. A S M E, Jl—Jan., 1918. Problems of engineering colleges. Efficient training.

Engineering Problems

Universal Public Service in Peace and War (83325 A). Ira N. Hollis. 6000 w. A S M E, Jl—Jan., 1918. Training needed; our weaknesses, etc.

Engineers

Some Comments on the Training of Engineers (83893 A). A. C. Lanier. 5000 w. E Cb St L, Jl—Nov.-Dec., 1917. Suggestions based on experience.

The Engineer in the Chemical Industry (83605 A). H. E. Hollister. 1800 w. E Cb Phila, Jl—Jan., 1918. Work accomplished since the war.

Laboratory Apparatus

Electrical Laboratory Apparatus for Educational Institutions (83621 A). J. J. Lamberty. Ills. 1200 w. Gen Elec Rev —Jan., 1918.

National Defense

The Engineering Societies in the National Defense (83326 A). Gano Dunn. 4500 w. A S M E, Jl—Jan., 1918. Things that are being done by engineers.

Reinforced Concrete

Some Observations Regarding the Methods of Teaching the Theory of Reinforced Concrete Design (83801 A). Allen B. McDaniel. 1500 w. Eng Ed—Dec., 1917. Suggests methods.

Research

American Research Methods (83808 B). Charles H. McDowell, with discussion. 20 pp. West Soc Engrs, Jl—Oct., 1917. Urges co-operation between industries and educational institutions.

The Co-ordination of Research (83911). 1300 w. Nature—Dec. 6, 1917. Prevailing opinions on the subject.

The Opportunity for Industrial Research (83337 A). C. E. Skinner. 2500 w. A S M E, Jl—Jan., 1918. The study of alloys.

See also Heat Flow, under MECHANICAL ENGINEERING, *Heating and Cooling.*

Schools

The Engineering School and the War (83799 A). A. F. Barnes. Presidential address to the S-W. Soc. of Engrs. 3000 w. Eng Ed—Dec., 1917. The effect of the war on American industries.

Spelling

How to Awaken Freshman Interest in Good Spelling (83802 A). A. C. F. Baebenroth. 1800 w. Eng Ed—Dec., 1917. Prevalence of faulty spelling.

Symbols

Symbols for Mechanics and Hydraulics (83800 A). John T. Faig. 1000 w. Eng Ed—Dec., 1917. Methods aiming to standardize practice; results obtained.

Training

Technical Training for Disabled Soldiers and Sailors (83317 A). Lord Charnwood, with discussion. 10 pp. Roy Soc Arts, Jl—Dec. 14, 1917. Size of the problem and schemes in preparation.

Training Engineers and Firemen (83971 A). Allen W. Ruggles. Ills. 2500 w. Ind Man—Feb., 1918. How the University of Wisconsin is educating them.

Welding

Plan for Training Welders for Army (83786). 1800 w. Weld Engr—Jan., 1918. Suggestions offered the war department.

FINANCE AND COSTS

Accounting

Accounting for the Liberty Loans (83888 A). Harvey S. Chase. 10 pp. Jl Actcy—Jan., 1918. Serial, 1st part.

Compensation

The Basis of Compensation for the Railroads (83543). Julius H. Parmelee. 1800 w. Ry Age—Jan. 10, 1918. Analysis of provisions suggested by President.

Coöperation

Buying Combinations in the Metal Market (83725). 5000 w. Min & Sci Pr—Jan. 19, 1918. From report on co-operation in American Export Trade; Federal Trade Commission.

Costs

Power Plant Proportional Investment Costs (83324). H. S. Knowlton. 5500 w. Natl Engr—Jan., 1918. Discussed in Boston Edison Street Lighting Rate Case.

Profits

Profit Earned and Profit Collected (83890 A). Frederick Thulin. 8 pp. Jl Actcy—Jan., 1918. Accounting problems.

Railway Finance

Railway Earnings and Expenses for the Year 1917 (83465 A). Frank Haigh Dixon. Diagram. 1800 w. Ry Age—Jan. 4, 1918. (Special No.) Heavy falling off in operating income.

Railroad Securities

How Will the Railroad Securities Be Affected? (83681). 1500 w. Ry Age—Jan. 18, 1918. Charts and review.

Selling Price

Determination of Selling Price (83889 A). E. D. Hilton. 7 pp. Jl Actcy—Jan., 1918. Critical discussion of recent pamphlet by Harrington Emerson.

Taxes

Plan to Recast War Excess Profits Tax (83661 A). 2200 w. Iron Age—Jan. 17, 1918. Important amendments proposed; some effects of Supreme Court decision.

Trade

The Government and Foreign Trade (83738 A). 1200 w. Elec Rev—Dec. 21, 1917. Serial, 1st part. British trade and methods developed for its future.

The Trade of India with Russia, France and Italy (83735 A). D. T. Chadwick, with discussion. 1500 w. Roy Soc Arts, Jl—Dec. 28, 1917. Effects of the war; and the economic future.

Valuation

Developments in Railway Valuation (83707). 5000 w. Ry Rev—Jan. 19, 1918. Statement by H. C. Philips of developments of federal valuation.

Solidification as a Factor in Railway Valuation (83683). H. M. Taylor. 1500 w. Ry Age—Jan. 18, 1918. Suggested method for determining the appreciation in the roadbed due to seasoning.

What About Your Plant Values? (83590). E. C. Constans. 1500 w. Telephony—Jan. 12, 1918. Outlines a simple system for valuing telephone plants.

War Revenue

The War Excess Profit Tax (83319). Philip Wiseman. 2800 w. Min & Sci Pr—Dec. 29, 1917. Meaning of "excess profit"; effect of tax law on gold-mining.

War Revenue Act and Its Relation to Taxpayers (83414). Daniel C. Roper. Address before editors of the trade press. 2000 w. Fndry—Jan., 1918.

War Tax

Intangible Values and War Tax (83972 A). Charles W. McKay. 4500 w. Ind Man—Feb., 1918. Discusses features of the war tax for industrial appraisals.

MANAGEMENT

Economic Departments

Uses of an Economic Department in a Machine-Tool Plant (83665). Ludwig W. Schmidt. 3500 w. Am Mach—Jan. 17, 1918. Reasons why such a department is of value in future policies.

Efficiency

Efficiency by Consent (83949 A). Louis D. Brandeis. 1100 w. Ind Man—Feb., 1918. Necessity of consulting with labor concerning industrial changes to secure full coöperation.

Training a Mining Organization in Efficiency Methods (83863). Charles A. Mitke. 2000 w. Eng & Min Jl—Jan. 26, 1918. Experiences at the Copper Queen.

Index Cards

Getting the Most Out of Index Cards (83973 A). F. J. Schlink. Ills. 2800 w. Ind Man—Feb., 1918. How cards can be notched to give graphic information.

Machine Arrangement

How to Locate Machine Tools (83970 A). Gustav H. Radebaugh. Ills. 2500 w. Ind Man—Feb., 1916. Coördinated system of machine arrangement.

Ordnance

Ordnance Bureau, U. S. A. (83976 A). 700 w. Ind Man—Feb., 1918. Editorial on the vastness of the task and the work of the Bureau.

American Ordnance in France (83339 A). Capt. Fogg. 1000 w. West Ry Cb, Pro—Nov. 19, 1917. Needs of the American Ordnance department.

Organization

An Industrial Achievement of the War (83960 A). L. P. Alford. 2500 w. Ind Man—Feb., 1918. Application of management principles to the U. S. Ordnance Bureau.

Master Control of American Industries (83975 A). 1800 w. Ind Man—Feb., 1918. Editorial on the need of control, with suggestions.

The Winchester Plan of Management (83437 D). W. E. Freeland. Ills. 3500 w. Iron Age—Jan. 3, 1918. (Special No.) Outlines a modified type of functional management, discussing the philosophy on which it is based.

The Winchester Engineering Organization (83660 A). W. E. Freeland. 3000 w. Iron Age—Jan. 17, 1918. Duties of chiefs of general manager's staff and their committee interrelations. Second article of series.

Handling Costs at Winchester Plant (83785 A). W. E. Freeland. Ills. 2500 w. Iron Age—Jan. 24, 1918. Part III.

Production

Production Standards for War (83916). 1000 w. Times Engng Supp—Nov. 30, 1917. Coördination between manufacturers and Government.

Profit-Sharing

A Fair Basis of Profit-Sharing (83974 A). George Kingdon Parsons. 4500 w. Ind Man—Feb., 1918. Unique system, apportioning profits to managers, salesmen, clerks, mechanics and laborers.

REGULATION

Administration Bill

The Administration Bill for Control of Railroads (83544). 6000 w. Ry Age—Jan. 10, 1918. Five-hundred-million appropriation.

Cantonments

Utility Staffs at National Army Cantonments Organized on Military Basis (83455). John M. Goodell. 2500 w. Eng News-Rec—Jan. 3, 1918. Organization for Camp Meade utility service.

Draughtsmen

The Status and Remuneration of Draughtsmen (83381 A). 2200 w. Engng—Dec. 14, 1917. The work; how to raise the status of draughtsmen.

Employees

Keeping the Good Will of the Employee (83349). H. D. Murphy. 1200 w. Am Mach—Jan. 3, 1918. Its importance; ideas on the subject.

Engineering Equipment

Supply Organization Expands 2250 Per Cent. to Equip Engineer Troops (83452). E. J. Mehren. 4000 w. Eng News-Rec—Jan. 3, 1918. Specification, design and purchase of a large variety of engineering equipment.

Fuel Administration

Five Coal-less Days and Ten Heatless Holidays (83815). 3000 w. Ry Age—Jan. 25, 1918. Fuel Administration orders a suspension of industries.

Garfield Defends Order That Shut Down Industries (83826). 2000 w. Cl Age—Jan. 26, 1918. Text of defense, with interview by Floyd W. Parsons.

Government Aid

Engineering Societies' War Activities (83478). 2500 w. Elec Wld—Jan. 5, 1918. Ways in which national technical societies have aided government.

Industrial Order

Widespread Closing Down of Industry (83784 A). 13 pp. Iron Age—Jan. 24, 1918. To give coal to vessels, relieve freight congestion and fuel shortage.

Labor

Crux of the War Situation is Labor (83536 A). Elbert H. Gary. 3000 w. Iron Age—Jan. 10, 1918. Address before the Commercial Club of Chicago. Favors bringing men from the Orient.

Fifth Annual Report of the Secretary of Labor—Fiscal Year Ending June 30, 1917 (83645 N). 150 pp. U S Gov Print Office—1917. Mediation in labor disputes, and other work of the Dept.

Monthly Review of the U. S. Bureau of Labor. Statistics (83795 N). 256 pp. U S Dept Labor—Dec., 1917.

Railway Labor Conditions (83758 A). 2500 w. Engng—Dec. 28, 1917. Developments in connection with rates of wages in Great Britain. Editorial.

Reducing Labor Turnover in Our Shops (83351). Fred H. Colvin. 220 w. Am Mach—Jan. 3, 1918. Different phases of the question.

Shop Stewards (83764 A). 1500 w Engr—Jan. 4, 1918. Discusses the recent agreement in England to recogniz the shop stewards.

Unionizing Industry as a War Measure (83538 A). Walter Drew. 1800 w Iron Age—Jan. 10, 1918. Its dangers.

Manufacturing

Manufacture After the War (83917 2000 w. Times Eng Supp—Nov. 30 1917. Problems of federation and association in England after the war.

Power

Mastering Power Production—I (83947 A). Walter N. Polakov. 3500 w Ind Man—Feb., 1918. Deals with general principles of arrangement and installation of plant equipment.

Public Utilities

Effects of War Conditions on Cos and Quality of Public Utility Servic (83564). 2000 w. Elec Ry Jl—Jan. 1 1918. Extra operating expense shoul be considered in modifying rates.

Practical Measures for Securin Greatest Economy in Public Utilit Plant Operation (83499 A). Charle Brossmann. 2500 w. Mun Eng—Jan 1918. Serial, 1st part. Specific recommendations for increasing efficiency.

Railroad Hearings

Railroad Hearings Before the Senat Committee (83470 A). 2500 w. Ry Ag—Jan. 4. 1918. (Special No.) Inte state Commerce Commission que tioned.

Railroads

Supreme Court Decisions Affecting Railroads (83819). 3000 w. Ry Age—Jan. 25, 1918. Abstracts of decisions in the Illinois and the Texas cases.

Steel

First of Government Regulation in Steel (83445 D). 4500 w. Iron Age—Jan. 3, 1918. (Special No.) Record ingot production.

War Board

Accomplishments of the Railroad's War Board (83471 A). 3500 w. Ry Age—Jan. 4, 1918. (Special No.) Report to Senate Committee tells also of what it had hoped to do.

War Industries

War Industries Board to Be Central Agency for Mobilizing Nation's Resources (83775). 1500 w. Eng News-Rec—Jan. 24, 1918. Plan outlined by Secretary Baker.

Germany's Contribution to Our War Preparation (83438 D). Ills. 1500 w. Iron Age—Jan. 3, 1918. (Special No.) A Bridgeport, Conn., plant, financed by Germany, for the production of shrapnel, taken over by U. S. government.

Women Workers

One Labor-Shortage Problem Solved—Women in Machine Shops a Success (83530). 2000 w. Eng News-Rec—Jan. 10, 1918. Efficient work on machine tools.

The Woman Worker. John W. Upp. Also, Psychology of Environment. C. B. Lord. With discussion of the two papers (83334 A). Ills. 7000 w. A S M E, Jl—Jan., 1917. Problems concerning women.

Women Fill Men's Places in Shops (83729 A). Articles by D. C. Buell, Harvey D. Wolcomb, and Margaret Lampert. 4500 w. Ry Mech Engr—Jan., 1918. Suggestions for their training.

Woman Power (83924). 1100 w. Times Engng Supp—Nov. 30, 1917. Account of the Exhibition of Women's Work.

Women in German Foundries (83771 A). From paper by Kurt Abeking in *Stahl und Eisen.* Ills. 1500 w. Ir & Cl Trds Rev—Dec. 28. 1917. Considers kinds of work and ways of instruction.

Women's Labor in British War Industries (83662 A). L. H. Quin. Ills. 4000 w. Iron Age—Jan. 17, 1918. Its great scope and problems involved: wages, efficiency and working conditions.

WELFARE AND SAFETY

Benefit Association

The Employees' Benefit Association (83968 A). W. L. Chandler. Charts. 6000 w. Ind Man—Feb., 1918. Second part of serial. Its relations to employee and employer and its management. Sick benefits, insurance, etc.

Dust

Dust in Industry (83887 A). Henry Field Smyth. 3000 w. Sci M—Jan., 1918. As a cause of occupational diseases.

Dust; Its Universality, Elimination and Conservation (83956 D). E. R. Knowles. Ills. 43 pp. Am Soc Ht & Vt Engrs, Jl—Jan., 1918. Classification of dusts, their sources, elimination, recovery.

Safety Work

A Year's Progress in Electrical Safety Work (83518). Morton G. Lloyd. 2500 w. Elec. Rev, Chi—Jan. 5, 1918. Results of first year's trial of the Natl. Elec. Safety Code.

Workmen's Compensation

Workman's Compensation Act (83474). Samuel R. Artman. 2500 w. Telephony—Jan. 5, 1918. Read at Indiana Ind. Tel. Convention. Experiences in administration.

MISCELLANY

Agriculture

The Agricultural Problem (83328 A). Liberty H. Bailey. (Abstract.) 3000 w. A S M E, Jl—Jan., 1918. Food production problems and their relation to the war.

German Industries

A Travers Les Revues Techniques Allemandes (83904 B). 2000 w. La Nature—Nov. 24. 1917. Extraction of greases, production of high-speed steel: copper, leather, rubber, and other industries as gathered from German technical papers.

War

The Business of War (83490). Charles T. Hutchinson. 2500 w. Min & Sci Pr—Jan. 5, 1918. Reviews conditions and the attitude of the industries and of labor.

War Aims

What We're Fighting For (83657). Frederick Landis, with introductory address. 22 pp. St L Ry Cb, Pro—Dec., 1917.

War Effects

Manchester Local Section: Chairman's Address (83613 N). C. J. Beaver. 8000 w. Instn E E, Jl—Dec., 1917. Effects of war on world's industry and industrial progress. Necessities revealed.

Birmingham Local Section: Chairman's Address (83615 N). Sydney T. Allen. 4000 w. Instn E E, Jl—Dec., 1917. Effects of the war and needed developments of electrical industries.

Western Local Section Chairman's Address (83612 N). R. Howard Fletcher. 2500 w. Instn E E, Jl—Dec., 1917. Problems arising from war necessities.

MECHANICAL ENGINEERING

AERONAUTICS

Aeroplanes

Aeroplane Construction in General (83493). Ottorino Pomilio. Ills. 2200 w. A A Wkly—Jan. 7, 1918. Serial, 1st part. Types and their construction.

Exploring and Mapping Jungle Lands by Aeroplane (83553 A). Russell Hastings Millward. Ills. 2200 w. Flying—Jan., 1918. Work of aviators after the war.

Some Notes on Recent German Aeroplanes (83389 A). Ills. 2000 w. Engr—Dec. 14, 1917. Information regarding certain types of captured machines exhibited in England.

Aircraft

The Aircraft-Problem (83332 A). W. F. Durand. 4000 w. A S M E, Jl—Jan., 1918. Problems in forming and maintaining a large and efficient air fleet.

The Amazing Development of Military Aeronautics in 1917 (83571). Henry Woodhouse. Ills. 2000 w. A A Wkly—Jan. 14, 1918. The importance of the air service.

Air Service

America's Air Service (83881 B). W. F. Durand. Ills. 26 pp. Fkn Inst, Jl—Jan., 1918. Account of the purposes of such a war measure and the requirements.

The War in the Air (83602 A). G. Douglas Wardrop. 2500 w. E Cb, Phila, Jl—Jan., 1918. What the Germans have accomplished and the problems to be solved.

Automotives

Automotives in the Great War (83700). Coker F. Clarkson. 3500 w. Am Mach—Jan., 24, 1918. Reviews the accomplishments during the past year.

Aviation

La Liason Aérienne Et La T. S. F. En Avion (83932 B). J. A. Lefranc. Ills. 2900 w. La Nature—Dec. 8, 1917. Aviation and radio operations by the Germans. Types of planes used, radio apparatus and fire control.

Aviators

Fighting Efficiency of American Aviators Can Be Quadrupled by Adoption of Walter Camp's Method of Training (83552 A). Henry Woodhouse. Ills. 1500 w. Flying—Jan., 1918. Value of training.

The Aviator, the Quarterback of War's Gridiron (83551 A). Walter Camp. Ills. 1800 w. Flying—Jan., 1918. Training to keep him in the physical, mental and nervous condition.

Ballooning

Free Ballooning (83554 A). F. P. Lahm. Ills. 1500 w. Flying—Jan., 1918. The care, equipment, management and usefulness.

Biplanes

The German Ago Fighting Biplane (83573). Ills. 3300 w. A A Wkly—Jan. 14, 1918. Detailed description.

The German A. E. G. Bombing Biplane (83492). Ills. 1800 w. A A Wkly—Jan. 7. 1918. Particulars of the 1917 type.

Engines

German Aeroplane Engines (83382 A). 1500 w. Engng—Dec. 14, 1917. Details of captured German aeroplanes and engines on exhibition at Islington, England.

British Aviation Engine Inspection (83562). R. K. Bagnall-Wild. Charts. 4000 w. Auto Ind—Jan. 10, 1918. Serial, 1st part. Chart scheme in use.

Overhauling the Gnome Airplane Engine (83348). Ills. 3500 w. Am Mach—Jan. 3, 1918. Instructions for disassembling and assembling.

The 160-Hp. Benz Aircraft Engine (83812 A). Ills. 1000 w. Auto Ind—Jan. 24, 1918. Design and performance data of one of Germany's leading aircraft engines.

Inclined Surfaces

The Influence of Aspect Ratio on the Critical Angle of Inclined Surfaces (83754 A). C. H. Powell. 500 w. Engng—Dec. 28, 1917. Investigations of value to aeroplane designers.

Model Experiments

The Wind Channel—Its Design and Use (83572). J. R. Pannell. Lecture before Aeronautical Soc. of Gt. Britain. 4000 w. A A Wkly—Jan. 14, 1918. Serial, 1st part. Value of model experiments, describing wind channels.

Naval Aircraft

Italian Naval Aircraft (83763 A). Ills. 700 w. Engr—Jan. 4, 1918. Details of a system of defence for the Adriatic. showing typical units.

Propellers

Automatic Airplane Propeller Shaping Machine (83753 A). Ills. 1200 w. Engng—Dec. 21, 1917. Detailed description of a British machine tool of interest.

Standard Hub for Airplane Propellers (83527). Fred H. Colvin. Ills. 500 w. Am Mach—Jan. 10, 1918. Details of hub adopted by the aviation section of the United States army.

War

War and Aeronautics (83806 A). William F. Beard. 5000 w. U S Nav Inst, Pro—Dec., 1917. The use of balloons in the Civil War.

AUTOMOBILES

Annual Show

Mechanical Tendencies Revealed by the Show (83561). P. M. Heldt. Ills. 3500 w. Auto Ind—Jan. 10, 1918. Interesting developments seen at the New York show.

Axles

Design of Military Truck Axles (83703). G. W. Carlson. Ills. 2000 w. Auto Ind—Jan. 17, 1918. Engineering details of front and rear axles of Class B military worm-driven truck.

Automobiles

Efficient Transportation Demanded by Engineers (83504 A). J. Edward Schipper. 3000 w. Auto Ind—Jan. 3, 1918. (Special No.) Change of practice necessary to eliminate extravagance of wheel base and engine size.

Car Tooling

Tooling a Foreign Car in America (83419 A). Thomas Orchard. Ills. 1400 w. Machy—Jan., 1918. Serial, 1st part. Interesting jigs and fixtures used in tooling an automobile of foreign design.

Electric Vehicles

The Electric Vehicle for Handling Goods in the Works and on the Road (83370 N). Raymond J. Mitchell. Ills. 4000 w. Elec'n—Dec. 14, 1917. The scope of the electric vehicle, construction of chassis, etc.

Engines

Reasons Behind the Class B Engine (83702). A. F. Milbrath. Diagrams. 2500 w. Auto Ind—Jan. 17, 1918. Technical analysis of its design. Performance in tests.

Fuel

Fuel for Automotive Apparatus (83813 A). E. W. Dean. Read before S. A. E. 6000 w. Auto Ind—Jan. 24, 1918. Distillation curves of the different fuels and their adaptability to present-day engines.

Petrol's Part in the Great War (83747 A). Albert Lidgett. Ills. 2500 w. Autocar—Jan. 5, 1918. Shows the great part motor spirit plays.

Ignition

Spontaneous Ignition (83373 A). 1500 w. Autocar—Dec. 22, 1917. Explanation of the causes of knocking and how they may be overcome.

Manifolds

Modern Manifolds (83505 A). Ills. 1000 w. Auto Ind—Jan. 3, 1918. (Special No.) Study of the intake manifold and methods for preheating it.

Mobilization Depot

A Motor Transport Mobilization Depot (83352 A). Ills. 1800 w. Autocar—Dec. 15, 1917. A permanent camp for men, vehicles and stores for oversea service.

Motor Transport

Army Transportation (83331 A). L. B. Moody. Ills. 500 w. A S M E, Jl—Jan., 1918. The importance of motor equipment in the Ordnance Department.

Spark Plugs

Special Spark Plugs Needed for Airplane Engines (83508 A). Ills. 4000 w. Auto Ind—Jan. 3, 1918. (Special No.) Factors which determine the construction are heat, oil conditions and gas tightness and insulation qualities under heat.

Starters

Impulse Starters for Tractors (83506 A). Ills. 1800 w. Auto Ind—Jan. 3, 1918. (Special No.) Enable a starting spark to be obtained without spinning engine.

Tractor Radiators

Tractor Radiators, Their Calculation and Design (83704). Arthur B. Modine. Diagrams. 2500 w. Auto Ind—Jan. 17, 1918. Portion of heat input compared with jacket losses.

Tractors

Rumely Adds Smaller Tractor Model (83811 A). Ills. 1800 w. Auto Ind—Jan. 24, 1918. Has a rating of 14-28 h.p.

Scotland Favors Light Farm Tractors (83507 A). 4000 w. Auto Ind—Jan. 3, 1918. (Special No.) More suitable for routine farm work.

An Agricultural Power Unit (83646 N). Alan E. L. Chorlton. Ills. 25 pp. Instn Aut Engrs—Dec., 1917. Serial, 1st part. Some factors governing the design of a small tractor.

Some British Agricultural Tractors and Haulers (83386 A). 3000 w. Engr—Dec. 14, 1917. Serial, 1st part. Progress in mechanical cultivation.

Truck Efficiency

Truck Efficiency Graphically Shown (83509 A). Francis W. Davis. 2000 w. Auto Ind—Jan. 3, 1918. (Special No.) Calculating truck's working capacity.

Truck Motor

Manufacturing Operations in Making a Gasoline Motor (83346). Ills. 1200 w. Am Mach—Jan. 3, 1918. Methods used in making and testing a four-cylinder truck motor.

Trucks

Freight Being Hauled Successfully Between New York and Philadelphia by Trucks (83677 A). Ills. 3000 w. Com Vhle—Jan. 15, 1918. 104-mile run daily on schedule time.

More Efficient Co-operation Delivery Demanded by War Conditions (83391 A). 3500 w. Com Vhle—Jan. 1, 1918. Shows that co-operative delivery by trucks cuts food costs and releases men for vital work.

Motor-Truck Transportation (83330 A). William P. Kennedy. 2500 w. A S M E, Jl—Jan., 1918. Developments to be expected to meet war necessities.

Three Class A 1½-Ton Q. M. C. Trucks Completed and on Way to Washington for Tests (83393 A). Ills. 1000 w. Com Vhle—Jan. 1, 1918. Characteristics.

War Conditions and Importance of Food Supply Forcing Farmers to Buy Trucks (83490 A). Ills. 3500 w. Com Vhle—Jan. 1, 1918. Labor shortage and railroad congestion help sales.

Wheels

The Hayter Road Wheel (83353 A). Ills. 1500 w. Autocar—Dec. 15, 1917. A construction which reduces the trouble of changing a pneumatic tire.

The Rapid Detachable Wheel (83746 A). Ills. 3000 w. Autocar—Jan. 5, 1918. Claims a locking mechanism enables a wheel to be detached or refitted in less than four seconds.

COMBUSTION MOTORS

Gas Engines

Gas Engine Troubles and Remedies (83829). A. L. Brennan, Jr. 1200 w. Power—Jan. 29, 1918. How to diagnose troubles and apply proper remedies.

HEATING AND COOLING

Air Conditioning

A Constant Temperature and Humidity Room for the Testing of Paper, Textiles, etc. (83608 B). F. P. Veitch and E. O. Reed. Ills. 4000 w. Jl Ind & Eng Chem—Jan., 1918. Control of humidity in industries.

Cantonments

For Soldiers in the Making (83669). Ills. 2500 w. Pr Pt Eng—Jan. 15, 1918. Refrigerating and ice making, water and heating plants installed at Rockford.

Cold Storage

Extra and Special Service by Cold Storage Warehouses (83576 A). F. M. Shoemaker. 2500 w. Ice & Refrig—Jan., 1918.

Multi-Stage Compression Plant of Central Cold Storage Co. (83583). Ills. 2500 w. Power—Jan. 15, 1918. Details of a modern two-unit ammonia plant of 500 tons refrigerating capacity employing new D. I. Davis system of multi-stage compression.

Science and the Cold Storage Industry (83632 A). J. Wemyss Anderson, with discussion. 5000 w. Roy Soc Arts, Jl—Dec. 21, 1917. Need of research work in England. Weak points and methods of strengthening them.

Drying

High Temperature Drying (83950 D). Burt S. Harrison. 14 pp. Am Soc Ht & Vt Engrs, Jl—Jan., 1918. Evaporation; design of high temperature installation. Air heating to high temperature.

Evaporation

The Temperature of Evaporation—Its Practical Application to Air Conditioning and to the Drying and Conditioning of Materials (83951 D). W. H. Carrier. 21 pp. Am Soc Ht & Vt Engrs, Jl—Jan., 1918. Wet bulb temperatures and the laws governing it, giving formulae, and discussing its bearing on air conditioning.

Fuels

Utilizing the Heat in a Pound of Coal (83843). Harold L. Alt. 2000 w. Ht & Vtg Mag—Jan., 1918. Analysis of the relation between heating and mechanical equipment from fuel standpoint.

Gas Heating

Appareils, Système Ionidès, Pour Le Chauffage Au Gaz (83945 B). Ills. 1200 w. Le Génie Civil—Dec. 15, 1917. The Ionidès apparatus for gas furnaces, dryers, etc.

Heat Flow

A New Principle in the Flow of Heat (83883 B). Carl Hering. 2200 w. Fkn Inst, Jl—Jan., 1918. Research work.

Heating

Answering Fuel Needs with a New Heating System (83957 D). George S. Barrows. Ills. 14 pp. Am Soc Ht & Vt Engrs, Jl—Jan., 1918. Details of the G. F. E. Rector system of gas heating.

What We Do and Don't Know About Heating (83954 D). John R. Allen. 2500 w. Am Soc Ht & Vt Engrs, Jl—Jan., 1918. Heat laws; heat losses from buildings; infiltration; radiation, etc.

Hot Water

Relation of Hot Water Service Heating to Various Types of Buildings (83953 D). Harold L. Alt. 2500 w. Am Soc of Ht & Vt Engrs, Jl—Jan., 1918. Data of use in computing the amount required and steam or coal calculations.

Hot Water Pipe

The Preservation of Hot Water Supply Pipe in Theory and Practice (83952 D). F. N. Speller and R. G. Knowland. Ills. 3500 w. Am Soc Ht & Vt Engrs, Jl—Jan., 1918. Principles of corrosion as applying to hot water supply systems.

Radiators

Report of Committee on Standard Method of Testing Radiators (83958 D). 1500 w. Am Soc Ht & Vt Engrs, Jl—Jan., 1918.

Refrigeration

Overhauling an Atmospheric Ammonia Condenser (83671). A. G. Solomon. Ills. 2500 w. Pr Pt Eng—Jan. 15, 1918. Troubles due to coils made of pipe galvanized on inside as well as outside.

See also Thermodynamics, under Measurement.

HYDRAULIC MACHINERY

Pumping

Some Canadian Pumping Plants (83460). A. Huguenin. Ills. 3000 w. Can Engr—Jan. 3, 1918. Details of plants illustrating various installations.

Pumps

The Application of Diaphragm Pumps to Metallurgical Work (83774 N). L. B. Eames. Ills. 1200 w. Chem, Met, & Min Soc of S Af, Jl—Oct., 1917. Its limitations and usefulness.

MACHINE ELEMENTS AND DESIGN

Bearings

Adjusting Marine Engine Bearings (83722). William M. McRobert. Ills. 1200 w. Power—Jan. 22, 1918. Suggestions for care of bearings.

Inventions

Inventions Relative to War Material (83601 A). W. Strother Smith. 6500 w. E Cb, Phila, Jl—Jan., 1918. Ways engineers can help in this field.

Machine Elements

Photo-Elasticity (83927). 1500 w. Times Engng Supp—Nov. 30, 1917. Optical method of studying elasticity and strain. Paper by E. G. Coker before Institution of Automobile Engineers.

MACHINE WORKS AND FOUNDRIES

Brass

Manufacture of Cartridge Brass in England (83781). 1000 w. Brs Wld—Jan., 1918. From paper by H. W. Brownsdon, read before Soc. of Chem. Ind., England. Conditions requiring closest attention to insure success.

Cannon

Cannon Making in Past Centuries (83663). H. H. Manchester. Ills. 1500 w. Am Mach—Jan. 17, 1918. Cannon manufacture between 1550 and 1800.

Castings

Casting Large Guns in the Early Eighties (83407). Job Goostray. Ills. 1500 w. Fndry—Jan., 1918. Difficulties encountered.

The Manufacture of Pattern Castings (83440 D). Henry M. Lane. Ills. 1500 w. Iron Age—Jan. 8, 1918. (Special No.) A new specialty foundry established by the Cope Pattern Works, of Detroit.

The Overweight Casting—Its Cause and Remedy (83409). R. R. Clarke. Ills. 7000 w. Fndry—Jan., 1918. Conservation of metal by proper molding.

Cores

How Cores Are Used to Cut Molding Costs (83405). Ills. 1500 w. Fndry—Jan., 1918. Account of large savings in molding by a more extensive use of cores.

Diamond Tools

Use of Diamond Tools in the Shop (83525). Frank A. Stanley. Ills. 2000 w. Am Mach—Jan. 10, 1918. Serial. 1st part. Classes of work for which they are adapted. Details of speeds, feeds and output.

Dies

Correcting Dies That Failed to Draw (83347). A. C. Lindholm. Ills. 1200 w. Am Mach—Jan. 3, 1918. How incorrectly designed dies were altered.

Die Work

Locating Small Holes Accurately in Die Work (83350). Hugo F. Pusep. 800 w. Am Mach—Jan. 3, 1918. Method for locating holes where it is impossible to use buttons.

Drawing

The Drawing-Office in Relation to Other Departments (83577 A). E. D. Roberts. Lecture to Jun. Instn. of Engr. 3500 w. Mech Wld—Dec. 21, 1918. Its relative position and importance.

Drilling

Modern Drilling Practice (83416 A). Edward K. Hammond. Ills. 10000 w. Machy—Jan., 1918. Basic principles to be obtained in the operation of drilling machines to secure maximum efficiency.

Economic Departments

See same heading under INDUSTRIAL MANAGEMENT, *Management.*

Electric Furnace

Harnessing the Electric Furnace to the Foundry (83408). Douglas Walker. Read before the Am. Fndry. Assn. 3000 w. Fndry—Jan., 1918. Progress showing merit of this electrical unit.

Forging

The Forging of an Off-Set Jaw (83964). J. V. Hunter. Ills. 2200 w. Am Mach—Jan. 31, 1918. Methods of casting and forging intricate parts.

Foundry Practice

Reminiscences of Early Steel Foundry Practice (83413). David McLain. Ills. 2500 w. Fndry—Jan., 1918. Read before Am. Fndry. Assn. Evolution of steel casting manufacture.

What Proper Routing Did for an Old Foundry (83415). H. E. Goetz, Ills. 1400 w. Fndry—Jan., 1918. Improvements resulting in greater efficiency.

Some Sand Mixing Methods (83780). C. Vickers. Ills. 1000 w. Brs Wld—Jan., 1918. Methods described.

Sweeping a Worm-wheel in Greensand (83692 A). James Edgar. Ills. 1000 w. Mech Wld—Dec. 28, 1917. Method suitable when there is no time to make a pattern.

Gas Furnaces

Gas Furnaces (83923). 1000 w. Times Engng Supp—Nov. 30, 1917. Abstract of paper by Arthur Forshaw, before Manchester Dist. Junior Gas Assn. Design and manipulation for various kinds of melting furnaces.

Gear Planers

The Sunderland Gear Planers (83378 A). Ills. & plates. 7000 w. Engng—Dec. 14, 1917. Explains principles governing the action.

High Temperatures

Dealing with Metals and Alloys Melting at High Temperatures (83578 A). Walter J. May. 1500 w. Mech Wld—Dec. 21, 1918. Suggestions for melting large quantities.

Interchangeability

Interchangeability, Tolerances and Finish (83791). J. P. Brophy. 2000 w. Am Mach—Jan. 24, 1918. Ideas as to requirements.

Lathes

Cincinnati Acme Universal Turret Lathe (83967). Ills. 1800 w. Am Mach—Jan. 31, 1918. Descriptive.

Details of 9-In. Center Heavy Duty Shell Lathe (83759 A). Ills. 500 w. Engng—Dec. 28, 1917. Describes a lathe built in Cincinnati, Ohio.

Machine Tools

After-War Prospects for American Machine Tools in France (83789). C. E. Carpenter. 2200 w. Am Mach—Jan. 24, 1918. Believes the demand will not decrease.

Machining

Machining Parts of a Calculating Machine (83667). Ills. 900 w. Am Mach—Jan. 17, 1918. Most parts described are made in punch presses from sheet metal. Test gages and press tools used.

Milling Machines

Plain Knee Type and Similar Milling Machines (83730 A). M. H. Williams. Ills. 7000 w. Ry Mech Engr—Jan., 1918. Their uses and possibilities in railway shops.

Patterns

Pattern for a Large Main Circulating Inlet Valve (83696 A). James Edgar. Ills. 1000 w. Mech Wld—Jan. 4, 1918. Directions for construction.

Precision Work

The Micrometer Head in Toolwork (83526). Hugo F. Pusep. Ills. 3000 w. Am Mach—Jan. 10, 1918. Methods.

Shell Tools

Boring and Reaming Tools for 220- and 270 m. m. French shells (83528). James Forrest. Ills. 1200 w. Am Mach—Jan. 10, 1918. Details of tools that have worked well.

Shop Practice

Correct Way of Making an Engine Piston Pattern (83412). Frank B. Raebig. Ills. 1500 w. Fndry—Jan., 1918. How to obtain economical results.

Manufacturing a Steel Chair (83664). G. F. Wetzel. Ills. 1500 w. Am Mach—Jan. 17, 1918. Methods of making an all-steel chair. Work on tubing and sheet metal.

Marking Off (83694 A). Joseph Horner. Ills. 1500 w. Mech Wld—Jan. 4, 1918. Serial. 1st part. Essential articles of the equipment, and methods used.

Operations in a Creamery Machinery Plant (83962). Frank A. Stanley. Ills. 2200 w. Am Mach—Jan. 31, 1918. Methods of coiling copper pipe on large modern drums, and of machining brass valves and plugs.

The Making of Plug and Ring Gages (83965). J. H. Smith. 2500 w. Am Mach—Jan. 31, 1918. Suggestions.

Springs

Laminated Steel-Spring Proportions (83963). H. H. Kennedy. 900 w. Am Mach—Jan. 31, 1918. Shows how various effects are secured.

Stoves

The Evolution of Cooking and Heating Stoves. (83410). Ills. 3000 w. Fndry—Jan., 1918. Early attempts in stove making.

Trade-Marks

Trade-Marks and the Manufacturer (83966). Glenn B. Harris. 2500 w. Am Mach—Jan. 31, 1918. Arguments in favor of trade-marks.

Typewriters

Making Typewriter Parts (83787). M. E. Hoag. Ills. 1000 w. Am Mach—Jan. 24, 1918. Serial. 1st part. Interesting milling and grinding fixtures are described in present number.

Welding

Comparison of Forge, Oxy-Acetylene and Electric Welding (83424 A). 1800 w. Machy—Jan., 1918. Essential factors in forge welding and their importance in the other processes.

Rehabilitating the Interned German Ships 83444 D). E. P. Jessop. Ills. 3000 w. Iron Age—Jan. 3, 1918. (Special No.) The part of electric welding in repairing the damaged ships—109 damaged vessels put in service in less than eight months.

Welding Transformer Tanks by Electric Arc Process (83417 A). Erik Oberg. Ills. 3000 w. Machy—Jan., 1918. Methods developed by the Pittsfield works of the General Electric Co.

MATERIALS OF CONSTRUCTION

Aluminum

L'Industrie Et Les Grandes Applications (83942 B). J. Escard. Ills. 5700 w. Le Genie Civil—Dec. 1, 1917. Industrial applications of aluminum and its various alloys.

Ferroalloys

Metallurgical Ferroalloys in 1917 (83862). Robert J. Anderson. 2500 w. Eng & Min Jl—Jan. 26, 1918. A review of the field.

Furnace Linings

Notes on the Disadvantages of Chrome Brick in Copper Reverberatory Furnaces (83873 D). Francis R. Pyne. 1000 w A I M E—Dec., 1917. Points out disadvantages when treating materials too valuable to allow metal absorption.

Inspection

Topical Discussion on the Subject of Inspection (83330 A). Papers by A. L. De Leeuw, F. A. Waldron, and B. W. Dunn, with discussion of all three. 11500 w. A S M E, Jl—Jan., 1918.

Molding Sand

Iron Oxide—Its Effect on Molding Sand (83406). W. R. Bean. Read before Am. Fndry. Assn. 1500 w. Fndry—Jan., 1918. Tests indicate that percentages over 3.5 per cent in sand are detrimental.

Muntz Metal

Typical Cases of the Deterioration of Muntz Metal (60:40 Brass) by Selective Corrosion (83961). Henry S. Rawdon. Ills. 35 pp. U S Bur Stnds. Tech paper 103—Dec. 15, 1917. Illustrated by four types, including tubings, sheets, and forgings.

Pig-Iron

Pig-Iron From Scrap-Steel (83320). Ills. 1200 w. Min and Sci Pr—Dec. 29, 1917. Synthetic pig-iron; production from scrap metal in the electric furnace.

Refractories

A Furnace for Testing Refractory Materials Under Load at High Temperatures (83594 A). Robert J. Montgomery. Ills. 1000 w. Met of Chem Eng—Jan. 1, 1918. A gas furnace which has been used successfully at the Koppers Co. laboratory.

Russian Timber

Les Richesses Forestières De La Russie (83906 B). C. Rabot. 1400 w. La Nature—Dec. 1, 1917. Estimate of the timber resources of Russia.

Screw Gages

Inspection of Screw Gages for Munitions of War (83423 A). Abstract of pamphlet by H. J. Bingham Powell. Ills. 5000 w. Machy—Jan., 1918. Measurement of pitch, and of full, effective, and core diameters.

Steel Plates

The Action of Caustic Liquors on Steel Plates (83394 A). C. E. Stromeyer. 2500 w. Engng—Dec. 14, 1917. Experiments showing the seriousness of the action of caustic soda.

Sulphuric Acid

The Sulphuric Acid Situation in the United States (83600 A). Lewis B. Skinner. 4500 w. Met of Chem Eng—Jan. 15, 1918. Information, including a discussion of the future of the industry.

MEASUREMENT

Differentiation

Mechanical Differentiation (83884 B). Armin Elmendorf. Ills. 2000 w. Frkn Inst, Jl—Jan., 1918.

Oil Tanks

Calculating the Contents of Oil Tanks (83723). R. T. Strohm. Ills. 1600 w. Power—Jan. 22, 1918. Methods of obtaining measurements.

Photo-Elasticity

See Machine Elements, under Machine Elements and Design.

Power Factor

Obtaining Power Factor by Use of Wattmeter (83686). E. G. Barrington. 1200 w. Elec Wld—Jan. 19, 1918. Explains manner in which power factor on three-phase circuits may be readily obtained

Power Plants

Power Plan Calculations (83323). W. F. Schaphorst. 2500 w. Natl Engr—Jan., 1918. Chart for determining power of a steam turbine.

Pyrometers

Les Pyromètres Electriques Industriels (83905 B). E. Coustet. Ills. 1400 w. La Nature—Dec. 1, 1917. Design and use of various forms of electric pyrometers.

Pyrometers and Pyrometry (83690 A). 3500 w. Eng Rev—Dec. 15, 1917. Serial, 1st part. Problems and achievements of modern pyrometry.

Pyrometry

Uses of Pyrometry (83925). 2800 w. Times Engng Supp—Nov. 23, 1917. Temperature measurement in industry; value of scientific methods, automatic temperature control, etc.

Screw Threads

Measurement of Internal Threads (83421 A). William S. Rowell. Ills. 500 w. Machy—Jan., 1918. Recommends the use of an inside micrometer with ball points to assist in making and gaging internal threads.

Thread Milling (83420 A). Franklin D. Jones. Ills. 13700 w. Machy—Jan., 1918. Advantages of milling process; different methods of forming screw threads by milling; types and designs of milling machines.

Screw-Thread Tolerances for Munitions (83788). Ills. 700 w. Am Mach—Jan. 24, 1918. Tolerances of U. S. S. form of screw threads as established by U. S. Ordnance Dept.

Springs

Helical Spring Computations (83422 A). Donald H. Reeves. 5000 w. Machy—Jan., 1918. Charts for determining dimensions and properties of springs in tension and in compression.

Spur Gears

Pin Measurement of Spur Gears (83418 A). Reginald Trautschold. Ills. 2500 w. Machy—Jan., 1918. Principles governing measurement. Formulas.

Suspended Templets

Suspended Templets and Their Application (83584). Terrell Croft. Ills. 1500 w. Power—Jan. 15, 1908. Their advantages and use and various methods of suspending them.

Thermodynamics

How to Use a Psychrometric Chart (83844). J. I. Lyle. 2000 w. Ht & Vtg Mag—Jan., 1918. Ten typical examples and their solution, based on the Carrier psychrometric chart.

Torsion

The Use of Soap Films in Solving Torsion Problems (83638 A). A. A. Griffith and G. I. Taylor. Abstract of paper read before Inst. of Mech. Engrs. Ills. 3000 w. Engr—Dec. 21, 1917. Describes experimental method developed.

Weirs

Verification of the Bazin Weir Formula by Hydro-Chemical Gaugings (83896 D). Floyd A. Nagler. Ills. 52 pp. A S C E, Pro—Jan., 1918. Results of 23 experiments on a standard Bazin weir. Methods of hydro-chemical and weir gauging used.

POWER AND TRANSMISSION

Air Pumps

Air Pumps (83760 A). Ills. 800 w. Engr—Dec. 28, 1917. Investigations on various methods of producing high vacuum.

Engines

The Centenary of the Heat Regenerator and the Stirling Air Engine (83388 A). Ills. 3000 w. Engr—Dec. 14, 1917. Specifications of Stirling's patent in 1816.

Lubrication

A Simple Problem in Forced Lubrication (83377 A). Lord Rayleigh. Ills. 700 w. Engng—Dec. 14, 1917. Maintaining the layer of lubricant between the opposed solid surfaces.

Economy in Lubricating Materials (83697 A). 1800 w. Mech Wld—Jan. 4, 1918. Serial. 1st part. Storing lubricants, lubricating devices, consumption, etc., are discussed.

Power

The Year's Progress in the Power Field (83400). Ills. 8500 w. Power—Jan. 1, 1918. A general review of important developments.

See same heading under INDUSTRIAL MANAGEMENT, *Regulation*.

Water Power

Engineering Council Urges Federal Water-Power Legislation (8374). 3000 w. Eng News-Rec—Jan. 24, 1918. From statement by Calvert Townley before the Water-Power committee of the U. S. Chamber of Commerce.

Notes on Water Supplies as Sources of Power (83374 A). Cecil H. Roberts. 2000 w. Surv'r—Dec. 14, 1917. Read before Instn. of Water Engrs. Wasted power; utilizing surplus water-power, etc.

STEAM ENGINEERING

Boilers

Boiler Management with Substitute Labor (83376 A). C. E. Stromeyer. 4000 w. Colly Gdn—Dec. 14, 1917. The problem of scarcity of labor and replacement by substitutes in the working of boilers.

Boiler-Room Efficiencies (83586). George F. Weaton, with discussion. Read before Providence (R. I.) Eng. Soc. 4500 w. Power—Jan. 15, 1918. Suggested equipment for 1000-h.p. installation.

Determining Boiler Efficiency by Co_2 Analyses and Flue Temperatures (83512). Haylett O'Neill. Charts. 1800 w. Power—Jan. 8, 1918. How to obtain valuable operating data by means of simple and cheap instruments.

New Method of Increasing the Evaporation in Boilers (83401). Carl Hering. 2000 w. Power—Jan. 1, 1918. A new thermal principle in water boiling.

Combustion

Automatic Combustion Control Saves Much Coal (83593). I. L. Kentish-Rankin. Ills. 1800 w. Elec Rev, Chi—Jan. 12, 1918. Saved 39 per cent. of coal bill in one hand-fired plant.

Smokeless Combustion of Coal (83670). Royce L. Beers. 3500 w. Pr Pt Eng—Jan. 15, 1918. Abstract of paper before the Smoke Prevention Assn. Fundamental conditions.

Condensers

Condensers (83427 B). Ills. 2000 w. Pwr Pt Eng—Jan. 1, 1918. Examples showing benefits of increased vacuum.

Condensers with Seventy-Foot Water Level Variation (83827). F. R. Brosius. Ills. 1200 w. Power—Jan. 29, 1918. Unusual type of construction to secure a supply of condensing water under unfavorable conditions.

Engines

Compound Steam Engines (83321). Carroll F. Merriam. 5000 w. Natl Engr—Jan., 1918. Advantages and limits of compounding and factors to be considered; the steam turbine and uniflow engine.

Notes on the Uniflow Steam Engine. (83375 A). A. G. T. Poole. Read before N. of Eng. Inst. of Min. & Mech. Engrs. Ills. 4500 w. Colly Gdn—Dec. 14, 1917. Method of working applications, types and tests.

Furnace Efficiency

Steam Boiler Furnace Efficiency (83322). S. S. Ledbetter. Ills. 3000 w. Natl Engr—Jan., 1918. Construction, operation and efficiency of powdered fuel plants.

Gas-Firing

Gas-Fired Boilers (83922). 1500 w. Times Engng Supp—Nov. 30, 1917. Abstract of paper by T. M. Hunter before Instn. Elect. Engrs. Best arrangement for different qualities of gas.

Turbines

Blade Rings (83399 B). Ills. 2000 w. Pr Pt Eng—Jan. 1, 1918. Types and arrangements.

Governing of Turbines (83425) B). Ills. 1200 w. Pwr Pt Eng—Jan. 1, 1918. Classification of methods.

Steam Turbines (83394 B). Ills. 3000 w. Pwr Pt Eng—Jan. 1, 1918. Types and classification, characteristics, etc.

Turbine Blading (83398 B). Diagrams. 3000 w. Pwr Pt Eng—Jan. 1, 1918. Shape and dimensions for blading of reaction types.

Turbine Economy (83426 B). Chart and curves. 1500 w. Pwr Pt Eng—Jan. 1, 1918. Effects of variation in steam pressure, superheat, vacuum and size.

Turbine Nozzles (83397 B). Ills. 2000 w. Pwr Pt Eng—Jan. 1, 1918. Determination of proper sizes and shapes. Materials used.

Turbine Piping (83396 B). Ills. 1200 w. Pwr Pt Eng—Jan. 1, 1918. Piping layouts for various turbine systems.

Arrangement of Turbines (83395 B). Ills. 2500 w. Pwr Pt Eng—Jan. 1, 1918. Reasons for vertical, horizontal, single and double flow, bleeder, mixed pressure, exhaust and reversing turbines.

Turbines—Types, Operative, Installations and Care (83428 B). Ills. 28 pp. Pwr Pt Eng—Jan. 1, 1918. Details of many types.

TRANSPORTING AND CONVEYING

Ash Handling

The Automatic Disposal of Ashes from Power Houses by Means of Ropeways (83369 N). J. Wallwyn White. Ills. 3000 w. Elec'n—Dec. 14, 1917. (Special No.) Ropeway installations are described.

Cargo Crane

The Modern Cargo Crane (83362 N). Claude M. Toplis. Ills. 5500 w. Elec'n—Dec. 14, 1917. (Special No.) Relative advantages of the electric, steam and hydraulic types.

Charging Machines

Charging Machines (83365 N). Fred G. Smith. Ills. 1500 w. Elec'n—Dec. 14, 1917. Saving in labor.

Coal Handling

Transferring Coal from Railroad to Vessel (83545 A). Ills. 2000 w. Ry & Loc Eng—Jan., 1918. Recent developments in mechanical handling.

Conveyors and Elevators (83367 N). W. H. Atherton. Ills. 2500 w. Elec'n—Dec. 14, 1917. Serial. 1st part. (Special No.) Types for coal and ash.

Conveyors

Selection of Coal and Ash Conveyors (83585). H. E. Birch. Ills. 3500 w. Pwr—Jan. 15, 1918. Operation, maintenance, investment and adaptability.

Cranes

Giant Crane for the United States Navy (83666). W. H. Shepard. Ills. 1000 w. Am Mach—Jan. 17, 1918. Details, showing size and capacity.

Examples of Electrically-Driven Cranes (83359 N). H. H. Broughton. Ills. 3500 w. Elec'n—Dec. 14, 1917. (Special No.) Importance of using machinery in place of unskilled labor.

Electric Equipment

Notes on the Electric Equipment of Machinery for the Handling of Materials (83360 N). Ills. 2500 w. Elec'n—Dec. 14, 1917. Serial. 1st part. (Special No.) Details of electrical equipment.

Electric Trucks

Electric Industrial Trucks Help Reduce Present Serious Labor Shortage (83392 A). Ills. 1200 w. Com Vhle—Jan. 1, 1918. Their use in munition plants and factories.

Elevators

Operation and Maintenance of Elevators—Winding-Drum Machines (83510). R. H. Whitehead. Ills. 2200 w. Power—Jan. 8, 1918. Details of a modern winding-drum type elevator machine.

Handling Materials

Belt Shipping Plants (83355 N). F. G. Mitchell. Ills. 1300 w. Advantages of the belt-conveyor for the shipment of coal and ore. Plant at Durban.

Economic Transport and Its Influence on the Price of Everything (83358 N). Alfred Warwick Gattie. 2500 w. Elec'n—Dec. 14, 1917. (Special No.) Illustrates the importance of the cost of transport.

Electrical Machinery in Coke-Oven Works (83364 N). Alwyne Meade. Ills. 2500 w. Elec'n—Dec. 14. 1917. (Special No.) Types used, arrangement, and power required.

Grabs (83363 N). Ills. 1800 w. Elec'n—Dec. 14, 1917. (Special No.) Details of mechanical construction, describing the electric grab and system of control.

Lessons from America in the Handling of Coal and Iron Ore (83354 N). G. H. Hutchinson. Ills. 4500 w. Elec'n—Dec. 14, 1917. (Special No.) Methods developed in the Lake Superior region.

The Equipment of Railway Goods Stations with Electrical Machinery for Dealing with General Merchandise (83356 N). Roger T. Smith. Ills. 8000 w. Elec'n—Dec. 14, 1918. (Special No.) Considers electricity superior to any other motive power. Examples given.

The Present-Day Handling of Our Foodstuffs by Machinery (83357 N). Ills. 4500 w. Elec'n—Dec. 14, 1917. (Special No.) Examples of the conveyor applied to handling important foodstuffs.

Ore Loading

Iron Ore Loading Plant at Bilbao (83756 A). George Frederick Zimmer. Ills. 900 w. Engng—Dec. 28, 1917. Describes the unusual features of the plant.

Telphers

Telphers and Transporters (83368 N). George Frederick Zimmer. Ills. 6000 w. Elec'n—Dec. 14, 1917. (Special No.) Compares merits of telphers and conveyors; describes types of telphers in use and performance that may be expected.

MISCELLANY

Glycerine

La Fabrication De La Glycérine (83903 B). A. Breton. Ills. 1900 w. La Nature—Nov. 24, 1917. Popular description of methods and apparatus commonly employed for manufacture of glycerine.

ELECTRICAL ENGINEERING

COMMUNICATION

Interference

Final Report on Inductive Interference (83627 A). 2500 w. Tel Engr—Jan., 1918. Review of the work of the California Joint Committee.

Radiotelegraphy

Wireless Transmitting Stations on German Aeroplanes (83740 A). From La Nature. Elec Rev—Dec. 28, 1917. Brief description.

Rectifier

A rectifier for Telephone Use (83591). Ills. 1500 w. Telephony—Jan. 12, 1918. Details of Tungar rectifier and its operation.

Reis Telephone

Reis Telephone and Nature of Sound (83851). Articles by Arthur Bessey Smith and by J. G. Mitchell. 1800 w. Telephony—Jan. 26, 1918. Discussions of the "break and make" theory of the Reis telephone in regard to its relation to sound.

Research

Industrial Research with Some Notes Concerning Its Scope in the Bell Telephone System (83629 A). F. B. Jewett. 6000 w. Tel Engr—Jan., 1918. Read at Philadelphia meeting of the A. I. E. E.

Telephony

Some Recent Improvements in Telephony (83628 A). Ray H. Manson. Ills. 5000 w. Tel Engr—Jan., 1918. Review of progress. Read at Rochester meeting of A. I. E. E.

The Marvel of the Telephone (83630 A). J. F. Greenawalt. 3000 w. Tel Engr—Jan., 1918. Read at meeting of New Mexico Electrical Assn. The story of its invention and development

ELECTRO-CHEMISTRY

Electrometallurgy

Electric Carbon Tool Steel (83769 A) John A. Holden. 2000 w. Ir & Cl Trds Rev—Dec. 28, 1917. Deals with the Heroult type of electric furnace for the production of tool steel.

La Récuperation Du Cuivre Et De L'Acide Dans Les Vieux Bains De Décapage (83934 B). 1600 w. L'Industrie Electrique—Nov. 25, 1917. Electrolytic process for recovering copper and acid from old cleaning baths.

The Properties of Electrolytic Copper—Modulus of Elasticity (83616 N). B. Welbourn. 700 w Instn E E, Jl—Dec., 1917. Results of investigation of the modulus which should be used for stranded conductors with Still's formula.

Galvano Work

Copper Galvano from Gutta Percha (83779). Joseph Haas, Jr. Ills. 1800 w. Brs Wld—Jan., 1918. Details.

Nickel Baths

The Preparation and Use of Rapid Nickel Baths (83411). E. P. Later. 3500 w. Fndry—Jan., 1918. Use of higher current densities, etc.

Nitrogen

Work of the British Nitrogen Products Committee (83509 A). 4500 w. Met & Chem Eng—Jan. 15, 1918. Preliminary report of plans under way for cyanamide, ammonia, oxidation, and experimental synthetic ammonia plants.

The Nitrogen Problem (83912). 1200 w. Nature—Dec. 6, 1917. Present status and outlook for the future among the allied nations.

Steam

See same heading under Power Applications.

ELECTRO-PHYSICS

Electrons

The Electron Theory (83882 B). William Albert Noyes. Ills. 16 pp. Fkn Inst, Jl—Jan., 1918. Development of this theory.

Electrostatics

A Graphical Method for the Construction of Electrostatic Fields (83885 B). Sylvan J. Crooker. 700 w. Fkn Inst, Jl—Jan., 1918. Method explained.

Magnetism

The Influence of Magnetism on Light (83886 A). L. R. Ingersoll, 1500 w. Sci M—Jan., 1918. Results of investigations.

Radio-Activity

See Philippine Waters, under CIVIL ENGINEERING, Water Supply.

Silver Sulphide

Some Electrical Properties of Silver Sulphide (83654). George W. Vinal. Ills. 9 pp. U S Bur Stnds, Sci paper 310—Nov. 24, 1917. Investigations and results.

X-Rays

A New Radiator Type of Hot-cathode Roentgen-ray Tube (83610 A). W. D. Coolidge. Ills. 2500 w. Gen Elec Rev—Jan., 1918. Describes a tube developed for military use.

A Portable Roentgen-Ray Generating Outfit (83620 A). W. D. Coolidge and C. N. Moore. Ills. 4000 w. Gen Elec Rev—Jan., 1918. Outfit for military service in the field.

GENERATING STATIONS

Brown Coal

Electrical Energy from Brown Coal (83372 N). Map. 1000 w. Comwh Engr—Nov. 1, 1917. Investigations made for the Victorian government in regard to the commercial utilization of brown coal.

Central Stations

New Central Station of Union Gas & Electric Company at Cincinnati (83853). Ills. 4000 w. Elec Rev, Chi—Jan. 26, 1918. Interesting features of a large plant nearing completion.

The Central Station Industry in the War Period (83514). T. Commerford Martin. 1500 w. Elec Rev, Chi—Jan. 5, 1918. Gross earnings total $500,000,000; coal core-makers necessary rate increase.

Electric Power

Scottish Local Section: Chairman's Address (83614 N). Archibald Page. 5000 w. Instn E E, Jl—Dec., 1917. Supply of electric power in the United Kingdom; what has been accomplished in Scotland; and future possibilities.

Electric Service

Effects of War Conditions on Cost and Quality of Electric Service (83342 D). Lynn S. Goodman and William B. Jackson. 16 pp. A I E E, Pro—Jan., 1918. Considers the effects of war conditions as they apply to the electric light and power service of the country.

Spirit of War in the Central West (83479). Ills. 2500 w. Elec Wld—Jan. 5, 1918. Electric utilities mobilizing resources to meet service.

Equipment

Methods of Drying Out Flooded Plant Equipment (83511). Norman L. Rea. Ills. 2000 w. Power—Jan. 8, 1918 Good ways for drying out electrical equipment after a plant has been flooded.

Fuel Conservation

Electrical Interconnections to Conserve Fuel (83477). Maps. 1500 w. Elec Wld—Jan. 5, 1918. States of New York and California show results.

Hydro-Electric

Helping France to Help Herself (83687)| Alexander C. Clogher and Victor F. Hammel. Ills. 2000 w. Elec Wld—Jan. 19, 1918. Urges the development of hydro-electric power to supplant coal supply.

Notes on Water Supplies as Sources of Power (83699). Cecil A. Roberts. 2200 w. Can Engr—Jan. 17, 1918. From paper before Instn of Water Engrs. Its important place in future activities of the world and the problems to be solved.

Some Commercial Aspects of Hydro-electric Development (83855). Calvert Townley. 3000 w. Elec Rev, Chi—Jan. 26, 1918. Statement of present conditions; a comparison of steam-electric and hydroelectric plants.

Ireland

Dublin Local Section: Chairman's Address (83610 N). O. T. O'Kelly Webber. 1200 w. Instn E E, Jl—Dec., 1917. The resources of Ireland and their development.

Power Plants

Joliet Plant a Step Toward Higher Steam Pressures (83688). Ills. 1200 w. Elec Wld—Jan. 19, 1918. Serial, 1st part. Features of boilers, piping and economizers, with arrangements for handling coal and supplying feed water.

Power Plant Practice During 1917 (83516). I. L. Kentish-Rankin. Ills. 4500 w. Elec Rev, Chi—Jan. 5, 1918. Review of experiences due to shortage of coal and labor, and economies effected.

New High-Pressure Joliet Plant (83719). Ills. 3500 w. Power—Jan. 22, 1918. Interesting features of a new generating station in Illinois.

Service Cost

Effects of War Conditions on Cost and Quality of Electric Service (83709). L. S. Goodman and W. B. Jackson, with discussion 7800 w. Elec Rev, Chi—Jan. 19, 1918. Analysis of conditions in electric light and power service and some of their remedies. From paper before A. I. E. E.

GENERATORS AND MOTORS

Fires

Extinguishing Fires in Large Totally Enclosed Generators and Motors (83618 A). M. A. Savage. Ills. 1500 w. Gen Elec Rev—Jan., 1918. Recommends the use of steam for extinguishing fires in windings where the construction permits its application.

Fires in Turbo-Generators (83721). M. A. Walker. 1800 w. Power—Jan. 22, 1918. Possible means of combating these fires.

Generator Test

A Solution for an Acceptance-Test Problem (83685). W. B. Kouwenhoven. 1500 w. Elec Wld—Jan. 19, 1918. Simple method of correcting generator-unit load—characteristic curve for variations in speed.

Insurance

Insurance of Electrical Machinery (83737 A). C. Stuart Buyers. 1200 w. Elec Rev—Dec. 21, 1917. Serial, 1st part. Underlying principles of the usual methods of insuring electric plant.

Motor Control

The Control of Motors Operating Transportation Machinery (83361 N). T. G. Travis. Ills. 1500 w. Elec'n—Dec. 14, 1917. (Special No.) Contactor control, particularly switchgear for cranes, transporters, etc.

Rotor Cores

Design of Rotor Cores for Electrical Machines (83570). William Knight. 800 w. Elec Wld—Jan. 12, 1918. Development of formulas for figuring stresses in high-speed rotor-core punchings.

Voltages

Voltages of Magneto Generators (83705). T. L. Channing. Ills. 1200 w. Telephony—Jan. 19, 1918. Factors upon which voltage depends.

ILLUMINATION

Colliery Lighting

Economizing the Colliery Electric Lighting Supply (83770 A). L. Fokes. 2500 w. Ir & C. Tds Rev—Dec. 28, 1917. Ways in which colliery lighting supply can be economically utilized and the consumption reduced.

Factory Lighting

Factory Lighting Codes and Rules (83969 A). C. E. Clewell. Ills. 4000 w. Ind Man—Feb., 1918. Review of progress, and regulations of Wisconsin, New York, Pennsylvania and New Jersey.

Historical Lighting

The Historical Lighting of Independence Square, Philadelphia (83832 C). E. F. Kingsbury, with discussion. Ills. 15 pp. Ill Eng Soc, Trans—Dec. 31, 1917. Details of the new lighting recently installed.

Nomenclature

1917 Report of the Committee on Nomenclature and Standards of the Illuminating Engineering Society (83831 C). 10 pp. Ill Eng Soc, Trans—Dec. 31, 1917.

Progress

Lighting Progress for the Past Year (83515). H. W. Mateer. Ills. 1500 w. Elec Rev, Chi—Jan. 5, 1918. Progress in industrial and street lighting; development of Mazda motion-picture lamp.

Reflectors

Some Experiments on the Eye with Pendant Opaque Reflectors Differing in Lining, Dimensions, and Design (83833 C). C. E. Ferree and Gertrude Rand. Ills. 24 pp. Ill Eng Soc, Trans—Dec. 31, 1917. Investigates seven opaque reflectors.

War Lighting

Some Features of Special War Lighting (83517). Grable B. Weber. Ills. 800 w. Elec Rev, Chi—Jan. 5, 1918. Lighting of munition plants and training camps.

POWER APPLICATIONS

Cranes

Motors and Control for Traveling Cranes (83689). C. E. Clewell. Ills. 2000 w. Elec Wld—Jan. 19, 1918. Eleventh article of a series on motor and control applications.

Electrical Apparatus

Development in Electrical Apparatus During 1917 (83519). 5000 w. Elec Rev, Chi—Jan. 5, 1918. Review of progress prepared by the Westinghouse Electric & Manufacturing Co.

Ice Plant

A Typical Motor-Driven Ice Plant (83854). Ills. 2500 w. Elec Rev, Chi—Jan. 26, 1918. Details of an electrically driven plant with central station supply.

Industrial Uses

Economic Industrial Applications of Electricity (83809 B). Norman T. Wilcox, with discussion. 13 pp. West Soc Engrs, Jl—Oct., 1917. Higher efficiencies possible through economic uses of electric service.

Lifting Magnets

Lifting Magnets (83366 N). Ills. 2500 w. Elec'n—Dec. 14, 1917. (Special No.) Operating costs, rating, control, etc.

Magnetic Pulleys

A Magnetic Steel Band Device (83693 A). P. L. Weston. Ills. 1200 w. Mech Wld—Dec. 28, 1917. From paper before Elec. Assn. of Aust. Experiments with magnetic pulleys and thin steel bands.

Motor Drive

Fan, Blower and Air-Compressor Applications (83858). C. E. Clewell. Ills. 2000 w. Elec Wld—Jan. 26, 1918. Twelfth article of a series. Operating characteristics of different types of apparatus for this service.

Motor Drive in the Preparation of Food (83582 A). Horace B. Smith. Ills. 2000 w. Elec Jl—Jan., 1918. Applications to coffee grinders, coffee roasters, meat choppers, meat slicing, ice cream freezers, churns, etc.

Planers

Operating Characteristics of Motor-Driven Planers (83569). C. E. Clewell. Ills. 2000 w. Elec Wld—Jan. 12, 1918. Relative merits of non-reversing and reversing motor equipment for planers.

Pumping

Electric Pumping with Results of Tests and Operating Records (83643 N). H. W. Wagner. Ills. 75 pp. Iowa State College, Bul 46—Oct. 3, 1917. Equipment and operation, costs, results of tests, etc.

Rainfall

L'Emploi De L'Électricité pour La Production Des Pluies (83935 B). 3300 w. L'Industrie Électrique—Dec. 10, 1917. Experimental methods for production of rain by creating an electric field.

Ship Building

See same heading under Marine and Naval Engineering.

Steam

La Production De La Vapeur Par L'Électricité (83907 B). H. Volta. Ills. 600 w. La Nature—Dec. 15, 1917. Steam generation by passing electric current through salt solution; the Revel system.

TRANSFORMERS

Testing

Simple Method of Testing Current Transformers (83708). 1200 w. Elec Rev, Chi—Jan. 19, 1918. Outline of tests by which laboratory equipment may be dispensed with.

TRANSMISSION AND DISTRIBUTION

Cables

Joint Boxes and Terminals for Split Conductor Cables (83741). Ills. 1200 w. Elec Rev—Jan. 4, 1918. Details of the Merz-Hunter protective system.

Frequencies

The Technical Story of the Frequencies (83341 D). B. G. Lamme. 1200 w. A I E E, Pro—Jan., 1918. Shows that the choice of frequency has mainly been based upon service conditions at the time.

Increased Loads

Adapting Existing Lines to Increased Loads (83481). Ills. E. B. Hook, Jr. 1500 w. Elec Wld—Jan. 5, 1918. Method of reinsulating line while alive; out-door substation built from equipment taken from other stations, etc.

Insulation

Electrical Properties of Vulcanized Fiber (83857). William Eves, 3d. 2000 w. Elec Wld—Jan. 26, 1918. Effect exerted by color, thickness and temperature on the breakdown value. Results of tests.

Secondary Networks

Successful Operation of Secondary Networks (83859). S. Bingham Hood. 2500 w. Elec Wld—Jan. 26, 1918. Discusses important points.

Short Circuits

The Suppression of Arcs Due to Accidental Grounds (83580 A). M. H. Collbohm. 3000 w. Elec Jl—Jan., 1918. Methods of providing for grounded circuit conditions; distinguishing features of these equipments.

Wiring

Best Practice in Service and Metering (83592). Edward B. Meyer. Ills. 2500 w. Elec Rev, Chi—Jan. 12, 1918. Precautions; advantages of full iron-clad wiring.

MISCELLANY

Electrcial Industry

Some Developments in the Electrical Industry During 1917 (83617 A). John Liston. Ills. 49 pp. Gen Elec Rev—Jan., 1918. Review of activities during the past year.

Electricity

Electrical Progress and Tendencies in 1917 (83513). Albert Scheible. 6500 w. Elec Rev, Chi—Jan. 5, 1918. Review of the year's advances.

Inst. E. E.

Inaugural Address (83609 N). C. H. Wordingham. 15000 w. Instn E E, Jl—Dec., 1917. How far the Institution meets the needs of the profession and industry and what improvements are possible.

CIVIL ENGINEERING

BRIDGES

Abutments

Turning Back Abutment Wing Walls Saves Material (83776). Charles K. Mohler. Ills. 2000 w. Eng News-Rec—Jan. 24, 1918. Revising layout of straight wall abutments.

Arches

Grandes Voutes (83944 B). A. Bonnet. Ills. 2400 w. Le Génie Civil—Dec. 15, 1917. Well known arches of long span, in different countries.

Concrete

Decision of U. S. District Court of Iowa on Certain Luten Patents for Concrete Bridges (83849). 2800 w. Eng & Con—Jan. 23, 1918. Extracts from opinion of Judge Martin J. Wade.

Mount Pleasant Road Bridge, Toronto (83587). J. S. Burgoyne. Ills. 3000 w. Can Engr—Jan. 10, 1918. Reinforced concrete structure consisting of a pair of cantilever beams of arched form with a free joint at center.

Erection

Problems and General Methods of Erecting the Sciotoville Bridge (83529). Clyde B. Pyle. Ills. 4000 w. Eng News-Rec—Jan. 10, 1918. Serial, 1st part. Original plan, with elimination of secondary stresses, in placing large two-span continuous structure over the Ohio River.

Hardinge

The Hardinge Bridge at Sara (83928). Ills. 2400 w. Times Eng Supp—Nov. 30, 1917. New structure for railway over the Ganges river.

CONSTRUCTION

Beams

Design of Restrained Beams Carrying Hydrostatic Load (83700). E. H. Darling. Ills. 1000 w. Can Engr—Jan. 17, 1918. Diagrams and explanation.

Caissons

Land Big Drop Shaft on Seal and Curb Wall (83674). Ills. 1200 w. Eng News-Rec—Jan. 17, 1918. Fifteen-pocket concrete caisson sunk 100 feet.

Cantonments

The Solution of the Cantonment Construction Problem (83333 A). Leonard Metcalf. 4000 w. A S M E, Jl—Jan., 1918. Details of the work of the Cantonment Construction Division.

Concrete

Traveling Towers Place 92,000 Yards of Concrete (83532). Ills. 1000 w. Eng News-Rec—Jan. 10, 1918. Stationary measuring plants on large steel mill work cut labor costs.

Concrete Piles

Les Fondations En Terrains Compressibles (83908 B). M. Bousquet. Ills. 2300 w. La Nature—Dec. 29, 1917. The Frankignoul system of concrete piling for foundation work in soft ground.

Foundations

Foundations of the New Buildings of the Massachusetts Institute of Technology, Cambridge, Mass. (83898 B). Charles T. Main and H. E. Sawtell. Ills. 37 pp. Bos Soc C E,Jl—Jan., 1918. Describes geological conditions, foundations and reasons governing types used, tests, etc.

Housing

Industrial Housing (83603 A). H. W. Forster. 3500 w. E Cb Phila, Jl—Jan., 1918. Type of housing needed, and facts relating to the situation.

Lighthouses

Caissons and Cribs for Lighthouse Foundations (83535). Ills. 2000 w. Eng News-Rec—Jan. 10, 1918. Lights in Detroit River have concrete piers built in timber cribs or formed by concrete caissons sunk in place.

M. I. T. Buildings

Concrete Materials and Design of the New Buildings of the Massachusetts Institute of Technology, Cambridge, Mass. (83899 B). Sanford E. Thompson. Ills. 13 pp. Bos Soc C E, Jl—Jan., 1918. Engineering studies and investigations that determined the structural features of these concrete buildings.

Portable Houses

Portable Houses for Overseas Forces Built in Record Time by New Methods (83456). Ills. 2000 w. Eng News-Rec—Jan. 3, 1918. Good management giving unusual results.

Reinforced Concrete

Reinforced Concrete Constructions; Marriott System (83757 A). Ills. 1200 w. Engng—Dec. 28, 1917. Uses to which this system has been applied, particularly in railway structures.

The New Chicago Rules for Design of Reinforced Concrete Slab Floors (83846). 3000 w. Eng & Con—Jan. 23, 1918. New ruling that went into effect Jan. 1, 1918.

Tunnel Lining

Pneumatic Mixer Tram on Mount Royal Tunnel (83773). F. C. K. Stuart. Ills. 3500 w. Eng News-Rec—Jan. 24, 1918. Keeping machines close to forms found to give best results.

IRRIGATION AND RECLAMATION

Australia

Irrigation Scheme on the River Murray, South Australia (83766 A). Ills. 500 w. Engr—Jan. 4, 1918. Details of recently completed installation at Berri.

California

Irrigation Project Is Based on Economic Use of Water (83778). 2000 w. Eng News-Rec—Jan. 24, 1918. Limited supply necessitates high duty.

Drainage

Durability of Cement Draintile and Concrete in Alkali Soils (83656 A). R. J. Wig, G. M. Williams, and A. N. Finn. Ills. 90 pp. U S Bur Stds, No. 95—Nov. 15, 1917. Investigations, tests, results and conclusions.

Run-Off from the Drained Prairie Lands of Southern Louisiana (83653 N). Charles W. Okey. 32 pp. U S Gov Print Office—Nov. 5, 1917. Investigations to establish the relation between the rainfall and amount of water necessary to pump to secure the growing of field crops.

Grading

Grading Land for Furrow Irrigation (83658 A). G. E. P. Smith. 2000 w. West Eng—Jan., 1918. Study of the relations between soil, slope, length of run, and unit head of water should be made.

Outlook

The Unprecedently Good Outlook for Irrigation in 1918 (83503 A). F. W. Park. Ills. 1500 w. Mun Eng—Jan., 1918. Increase in production due to irrigation, and the possibilities.

MATERIALS OF CONSTRUCTION

Cement

The Effect of Calcium Sulphate on Cement (83782 N). J. C. Witt and F. D. Reyes. 2000 w. Phil Jl Sci—May, 1917. Research work to determine the effect of various amounts of calcium sulphate on several cements.

Concrete

The Logical Proportioning of Concrete Aggregate (83803 A). Joel D. Justin. 17 pp. Corn C E—Dec., 1917. Explains a method of proportioning and its advantages and disadvantages.

Glass Sand

Optical Lens Manufacture Possible Using Glass Sand of West Virginia (83344). R. W. Stone. Ills. 2500 w. Mfrs Rec—Jan. 3, 1918. Analyses of glass sand from Berkeley Springs, W. Va.

Household Materials

Materials for the Household (83655 A). Ills. 245 pp. U S Bur Stds, Circ. 70—Dec. 5, 1917. Describes the more common materials, other than food and drugs, used in the home; their quality and use.

Reinforced Concrete

Effect of Fire on the Flat Slab Building of the Quaker Oats Co., Peterboro, Ont., Dec. 11, 1916 (83807 B). T. D. Mylrea, with discussion. Ills. 38 pp. West Soc Engrs, Jl—Oct., 1917. Studies the effect of the fire on this reinforced concrete flat slab construction.

Resources

Our Resources (83595 A). G. W. Thompson. 4500 w. Met & Chem Eng—Jan. 1, 1918. Presidential addresses delivered at the St. Louis meeting of Am. Inst. of Chem. Engrs. Ability to use material resources.

Sewer Pipe

The Supporting Strength of Sewer Pipe in Ditches and Methods of Testing Sewer Pipe in Laboratories to Determine Their Ordinary Supporting Strength (83642 N). A. Marston, W. J. Schlick, H. F. Clemmer. Ills. 56 pp. Iowa State College, Bul. 47—Oct. 10, 1917. Discussions, tests and conclusions.

MEASUREMENT

Flat Slab

Simple Formulas for Rapid Design and Estimates of Flat Slab Based on the Last Joint Committee Report on Concrete and Reinforced Concrete (83847). M. W. Serby. 700 w. Eng & Con—Jan. 23, 1918.

Graphics

Graphical Method of Finding Moments in Continuous Frames of a Girder and Two Fixed Columns (83845). W. S. Wolfe. Ills. 1500 w. Eng & Con—Jan. 23, 1918. Explains method of solving such problems.

Orifices

The Effect on Orifice and Weir Flow of Slight Roundings of the Upstream Edge (83804 A). Jacob O. Jones. Ills. 2200 w. Corn C E—Dec., 1917. This article gives investigations on orifices. Weir flow was dealt with in Nov. issue.

Survey Monuments

City Survey Monuments (83458). H. L. Seymour. Ills. 3500 w. Can Engr—Jan. 3, 1918. Reviews the practice of several Canadian cities.

Track Stresses

Progress Report of the Special Committee to Report on Stresses in Railroad Track (83897 D). Ills. 193 pp. A S C E, Pro—Jan., 1918.

MUNICIPAL

Activated Sludge

The Activated Sludge Experiments at Pasadena, Cal. (83524). Ills. 1500 w. Eng & Con—Jan. 9, 1918. Details of the plant and its operation.

Disinfecting

Combating Disease Organisms in Quarantine Stations and in Hospitals (83371 N). Henry A. Dixon. Ills. 2500 w. Comwh Engr—Nov. 1, 1917. Details of steam disinfecting apparatus.

Garbage

Utilization of City Garbage for Fuel Briquettes and Other Products (83345). William H. Phillips. 1200 w. Mfrs Rec—Jan. 3, 1918. Plans for the economic disposal of garbage.

Sanitation

Malaria-Control Engineering in Texas Increases Labor Efficiency (83777). Charles Scoville and H. W. Van Hovenberg. Ills. 2200 w. Eng News-Rec—Jan. 24, 1918. Mosquito-prevention work along a large railroad.

Sanitary Work in the Army (83691 A). Arthur J. Martin. 7000 w. Surv'r—Dec. 21, 1917. Serial, 1st part. Public lecture in London. Details.

Sewers

Efficiency of Storm-Water Sewers Depends on Inlets (83534). Irving P. Kane. 1000 w. Eng News-Rec—Jan. 10, 1918. Type, location, and adjacent paving should suit conditions.

Street Cleaning

Sanitary Street Cleaning (83459). George A. Wiseman. Ills. 2500 w. Can Engr—Jan. 3, 1918. Reviews methods, favoring flushing.

Waste

Industrial Waste Problems with Reference to the Smaller Cities (83501 A). Langdon Pearse. 4500 w. Mun Eng—Jan., 1918. Sewage treatment, water supply, pollution, etc.

ROADS AND PAVEMENTS

Asphalt

Methods and Cost of Constructing Kentucky Rock Asphalt Road (83429). William S. Canning. Ills. 1200 w. Eng & Con—Jan. 2, 1918.

Stone-Filled Street Asphalt Suffers from Inattention to Detail (83672). Clifford Richardson. 1200 w. Eng News-Rec—Jan. 17, 1918. Uniform composition necessary. One and a half inches on a close binder is best.

Brick

Construction Plant and Methods Employed in Building South Meridian Monolithic Brick Road, Indianapolis, Ind. (83497 A). Maurice B. Greenough. Ills. 600 w. Mun Eng—Jan., 1918. Use of mechanical equipment in surfacing.

Concrete

A Concrete Roadway System in a Shop Yard (83540). Charles E. Parks. Ills. 2500 w. Ry Age—Jan. 10, 1918. Walks built by the Santa Fe in storehouse and shops at Topeka, Kan.

Concrete Roads as a Solution to Our National Transportation Problem; Their Construction, Maintenance and Development (83895 A). Clinton H. Fisk. 20 pp. E Cb St L, Jl—Nov.-Dec., 1917. The engineering possibilities of concrete as a road material.

Design and Construction of Concrete Roads in Wood County, W. Va. (83498 A). Burdette Woodyard. Ills. 1000 w. Mun Eng—Jan., 1918. Methods, materials, etc.

Concrete Pavements

Reinforcement for Concrete Pavements (83496 A). Ills. 1500 w. Mun Eng—Jan., 1918. Methods that have proved satisfactory.

Good Roads

Good Roads — a War Necessity (83575). George A. Ricker. 2500 w. Br Rds & Sts—Jan., 1918. Address at Toledo, O. Conditions making permanent roads necessary.

Real Motor Truck Roads and a Federal Statute Controlling Operation in Every State Are Now Necessary (83678 A). Windsor T. White. 3500 w. Com Vhle—Jan. 15, 1918. Important projects proposed.

Highways

The Construction and Maintenance of Highways Under War Conditions (83432). Arthur H. Blanchard. 2000 w. Eng & Con—Jan. 2, 1918. Factors that have retarded improvement.

Notes on Road Building in Washington's Time (83810 B). A. N. Johnson. 1500 w. West Soc Engrs, Jl—Oct., 1917. Information of interest.

Military Roads

Military Roads (83574). William D. Sohier. Address at Richmond, Va. 8500 w. Br Rds & Sts—Jan., 1918. Importance of stronger roads and their maintenance. Work in England, France and Italy.

Military Roads (83430). From address by William D. Sohier. 6500 w. Eng & Con—Jan. 2, 1918. Importance at the present time; roads in France; maintenance; road building in Italy, England and Wales.

Pavements

Present Status of Granite Block Pavements (83701). Clarence D. Pollock. 2200 w. Can Engr—Jan. 17, 1918. Abstract of paper read before Am. Assn. for Adv. of Science. The modern granite-block pavement.

Rattler Test

Rattler Test Called Unfair to Shallow Paving Brick (83531). William C. Perkins. 1500 w. Eng News-Rec—Jan. 10, 1918. Experience shows need of allowance to correct losses.

Repairs

Relative Efficiency in Methods of Repairs to Bituminous Macadam and Bituminous Concrete Pavements (83388). George H. Biles. Read before Am. Assn. for Adv. of Sci. 3000 w. Can Engr—Jan. 10, 1918. Saving methods.

Surfaces

Condition of Road Surface Outweighs Type of Bitumen (83533). 2200 w. Eng News-Rec—Jan. 10, 1918. Other details of secondary importance.

Recent Developments in the Design and Construction of Road Surfaces (83431). Abstract of paper by H. Eltinge Breed. 3000 w. Eng & Con—Jan. 2, 1918. Changes that will have the most influence on the development.

WATER SUPPLY

Cantonments

Water Supply Specifications for National Army Cantonments Reviewed (83454). Dabney H. Maury. 2500 w. Eng News-Rec—Jan. 3, 1918. Attention given to quality, quantity and pressure.

Charges

The Basis of Water Charges in Urban Areas from the Point of View of Common Utility (83589). E. C. Rodda. Extracts from paper read before Munic W-Wks. Assn., at Birmingham, Eng. 2500 w. Can Engr—Jan. 10, 1918. Methods of raising revenue in certain communities.

Cleaning Mains

The Mechanical Cleaning of Water Mains in Rochester, N. Y. (83500 A). Edward H. Keith. Ills. 1500 w. Mun Eng—Jan., 1918. Details of work and advantages.

Concrete Pipe

Making and Placing Ten Miles of Concrete Pipe for Winnipeg Aqueduct (83673). K. B. Kumpe. Ills. 1800 w. Eng News-Rec—Jan. 17, 1918. Rapid casting of pipe 5½ feet in diameter and 8 feet long for pressure end of a pipe line.

Dams

Demolition of the Ragged Rapids Dam (83698). Sidney Bowen. Ills. 1600 w. Can Engr—Jan. 17, 1918. Reinforced concrete dam dynamited under full head of water.

Floating-Crest Gates Used on Sherburne Lakes Dam (83676). Ills. 1200 w. Eng News-Rec—Jan. 17, 1918. Automatic movable crest, with radial top plate and cylindrical down-stream plate, devised for isolated site.

Mineral Springs

Mineral Springs of Canada. Part I. The Radioactivity of Some Canadian Mineral Springs (83652 N). John Satterly and R. T. Elworthy. Map & Ills. 23 Plates. 55 pp. Can Dept Mines—Bul. No. 16. Results of investigations.

Philippine Waters

The Radioactivity of Philippine Waters (83783 N). J. R. Wright and George W. Heise. Maps & Ills. 3000 w. Phil Jl Sci—May, 1917. Reports investigations of typical waters.

Purification

Combined Water Purification and Softening Plant of Great Falls, Mont. (83523). Ills. 2000 w. Eng & Con—Jan. 9, 1918. Features of plant that have given good results.

Design and Construction of the Water Purification and Softening Plant at Great Falls, Montana (83494 A). Robert E. McDonnell. Ills. 2500 w. Mun Eng—Jan., 1918. Descriptive.

Water Works

Practical Hints on Various Features of Water Works Design (83502 A). J. W. Ledoux. 6000 w. Mun Eng—Jan., 1918.

WATERWAYS AND HARBORS

Barge Canal

New York's New Canal Ready in 1918 (83403 A). M. E. Mutchler. Ills. 2000 w. Mar Rev—Jan., 1918. Engineering problems solved in its construction.

Copenhagen

Copenhagen's Free Port (83915). Julius Moritzen. Ills. 1500 w. Nautical Gazette—Jan. 3, 1918. Development of this port during last twenty-five years. Prospects for the future.

Dunkirk

Les Agrandissements Du Port De Dunkerque (83909 B). A. Breton. Ills. 1300 w. La Nature—Jan. 5, 1918. Harbor improvements and fortifications made at Dunkirk since war began.

France

Travaux D'Après-Guerre Dans Les Ports, Les Rivières Et Les Canaux (83941 B). P. Mallet. 4000 w. Le Génie Civil—Dec. 1, 1917. Serial, 1st part. Plans for work after the war on seaports, rivers and canals.

French Ports

Les Ports Français Et La Guerre (83939 B). A. Pawlowski. 5800 w. Le Génie Civil—Nov. 24, 1917. French ports and the war. Summary and conclusion of a series of articles on this subject published during the past year.

Ireland

Belfast Harbor (83920). 1600 w. Times Engng Supp—Nov. 30, 1917. New scheme for improvement and enlargement to accommodate increased traffic.

Lakes to Gulf

Imperative Need of the Lakes to the Gulf Deep Waterway (83495 A). H. B. Morgan. 1500 w. Mun Eng—Jan., 1918. Importance of connecting the Great Lakes with the Gulf of Mexico, through the Mississippi River.

Pacific Coast

The Neglected Waters of the Pacific Coast—Washington, Oregon, and California (83794 N). E. Lester Jones. Ills. & Maps. 16 pp. U S Dept Com—Special Pub. No. 48. Shows present-day conditions and the remedy.

Scotch Canals

Mid-Scotland Ship Canals (83637 A). Maps & Ills. 3000 w. Engr—Dec. 21, 1917. Serial, 1st part. The Loch Lomond scheme is discussed in the present article.

MARINE AND NAVAL ENGINEERING

Concrete Ships

Concrete for Ships (83918). A. T. Wall. 2000 w. Times Engng Supp—Nov. 30, 1917. Part I—Properties of the material.

Ferro-Concrete Shipbuilding in Norway (83556 A). Robert G. Skerrett. Ills. 1800 w. Int Mar Eng—Jan., 1918. Vessels built by the Fougner Steel-Concrete Shipbuilding Co., of Christiana.

Les Chalands Et Navires En Béton Armé (83940 B). Ills. 3800 w. Le Génie Civil—Dec. 1, 1917. Construction of barges and boats of reinforced concrete in Norway.

England

England's Ship Needs (83931). 2500 w. Nautical Gazette—Dec. 20, 1917. Abstract of recent debate in House of Commons. The "Standard" ship criticised.

Freighters

Results of Test on Bulk Freighter (83402 A). A. George Matteson and Thomas Durkin. Read before Soc. Nav. Archts. & Marine Engrs. Ills. 1500 w. Mar Rev—Jan., 1918.

Models

Cargo Ship Lines of Simple Form (83557 A). William McEntee. Ills. 800 w. Int Mar Eng—Jan., 1918. Results of tests of models.

Motorships

Shallow Draft Motorships for Use on the Volga River Designed by American Naval Architect for Russian Owners (83555 A). Ills. 700 w. Int Mar Eng—Jan., 1918. Oil tankers of 3500 tons carrying capacity, and cargo boats of 1500 tons capacity, limited to 7 feet and 5 feet draft respectively.

Pile Driving

Drive 15,000 Piles for Pair of Thousand-Foot Shipways (83453). Ills. 1200 w. Eng News-Rec—Jan. 3, 1918. Using machines with two-way motion rolling on finished rows.

Ship Building

Outlines of the Shipping Board Inquiry (83914). E. N. Hurley. 3400 w. Nautical Gazette—Dec. 27, 1917. Address to the Senate Investigating Committee. Ships contracted for. Review of work accomplished so far.

America's Great Shipbuilding Development (83435 D). C. E. Wright. Ills. 4500 w. Iron Age—Jan. 3, 1918. (Special No.) Progress made despite handicaps in getting plants ready.

Progress of Ship Construction at Emergency Fleet Yards (83848). 2000 w. Eng & Con—Jan. 23, 1918. Outlines progress in shipbuilding by Chairman Hurley of the Shipping Board.

Over $400,000,000 for Steel and Wooden Ships Now Building in South (83560). Ills. 12 pp. Mfrs Rec—Jan. 10, 1918. Summary of shipbuilding activities along the South Atlantic and Gulf coast.

Shipbuilding Expedited by Electric Service (83482). David Elwell. Ills. 3000 w. Elec Wld—Jan. 5, 1918. Power requriements and details of electrical distributing system for Staten Island Shipbuilding Co.

Shipping

Our Transport Problem (83913). Irving T. Bush. 2200 w. Nautical Gazette—Dec. 13, 1917. Address to N. Y. Chamber of Commerce explaining the ocean transport problem of the U. S.

Ships

1917 and the Question of Ships (83765 A). With editorial. 4500 w. Engr—Jan. 4, 1918. Effects of submarine warfare; the pressing need of ships.

Shipyards

Report of the Shipyard Employment Managers' Conference (83644 N). 60 pp. U S Gov Print Office—1918. Report of conference held under the auspices of the industrial service department of the division of construction.

Three Government Shipyards Huge Problem in Plant Layout (83450). Ills. 5500 w. Eng News-Rec—Jan. 3, 1918. Design of government plants for building fabricated steel ships.

Submarine Chasers

Italian Submarine Chasers (83761 A). Ills. 300 w. Engr—Dec. 28, 1917.

Submarines

La Défense Du Commerce Maritime (83946 B). 4700 w. Le Genie Civil—Dec. 15, 1917. Serial, 1st part. Progress in defense of the merchant marine.

Une Demi-Année De Guerre Sous-Marine (83900 B). Ills. 2300 w. La Nature—Nov. 17, 1917. Charted records of sinkings, unsuccessful attacks and losses of both neutrals and allies.

Torpedoes

Les Modèles Actuels De Torpilles Automobiles (83943 B). M Stroh. Ills. 6200 w. Le Génie Civil—Dec. 8, 1917. Interior mechanism and apparatus of several types of torpedo.

Wooden Vessels

Anyox—A New Wooden Ore Carrier (83404 A). Robert C. Hill. Ills. 2000 w. Mar Rev—Jan., 1918. Details of a recently completed steamer.

MINING AND METALLURGY

BASE METALLURGY

Arizona

The Story of the U. V. X. Bonanza (83487). T. A. Rickard. Ills. & Maps. 5000 w. Min & Sci Pr—Jan. 5, 1918. Serial, 1st part. History of a long and discouraging development of copper mines splendidly vindicated.

Copper

Ajo Copper Mine (83878). Courtenay De Kalb. Ills. 3000 w. Min & Sci Pr—Jan. 26, 1918. Serial, 1st part. Production; history of development: geology, etc.

Andes Copper Mining Co.'s Development at Potrerillos, Chile (83733). James E. Harding. Ills. 1200 w. Eng & Min Jl—Jan. 19, 1918. At an expense of $25,000,000 a deposit of 1.4 per cent. copper ore, estimated at 100,000,000 tons, will be exploited by Anaconda.

Progress in Metallurgy of Copper (83736 A). H. C. H. Carpenter. 7500 w. Roy Soc Arts, Jl—Jan. 4, 1918. Serial, 1st part. History of the copper production and the reversal of the output; describes the Welsh process of copper smelting and refining; and outlines best modern practice in United States.

Some Notes on the Copper Deposits of the Northern Interior of British Columbia (83892 N). John D. Galloway. 2000 w. Can Min Inst, Bul—Jan., 1918. Promising properties and their development.

The Bogomolovsky Copper Mines, Russia (83724). N. T. Truschkoff. Ill.s & Map. 1500 w. Min & Sci Pr—Jan. 19, 1918. Characteristics of mines; a great pyrite belt; geology; development; costs.

The Lake Superior Copper Country (83622). Homer Guck. Ills. 1500 w. Min & Sci Pr—Jan. 12, 1918. Story of the Calumet & Hecla development.

Zinc

Joplin and the Kornspelter Region (83491). Otto Ruhl. 1500 w. Min & Sci Pr—Jan. 5, 1918. Depression in the zinc industry.

The Wisconsin Zinc District (83877 D). H. C. George. Ills. 30 pp. A I M E—Dec., 1917. Mines, scattered deposits, production, etc.

COAL AND COKE

Anthracite

Anthracite Industry in 1917 (83712). Edward W. Parker. 3000 w. Cl Age—Jan. 19, 1918. Important features of the anthracite industry during the year.

Anthracite in New England in 1917 (83714). G. G. Wolkins. 1200 w. Cl Age—Jan. 19, 1918. Slow and inadequate deliveries. Increased costs.

Mining anthracite in the Pennylvania Wyoming Region in 1917 (83825). J. H. Haertter. 1200 w. Cl Age—Jan. 26, 1918. Production, methods, electric locomotives.

Résumé of the Anthracite Industry in 1917 (83823). H. M. Crankshaw. Ills. 1000 w. Cl Age—Jan. 26, 1918. Methods adopted to increase production.

Briquettes

A Modern Belgian Briquette Factory, with the "Cava" Pitch Process (83750 A). E. Gevers-Orban. Ills 1600 w. Colly Gdn—Dec. 28, 1917. Details of factory and methods.

Briquetting

Briquetting of Anthracite Coal (83865 D). W. P. Frey. Ills. 2000 w. A I M E, Bul—Jan., 1918. Explains how success has been attained.

Brown Coal

See same heading under ELECTRICAL ENGINEERING, *Generating Stations.*

Coal Conservation

Interim Report of the Coal Conservation Sub-Committee of the Reconstruction Committee (83743 A). Abstract, with editorial. 1000 w. Elec'n—Dec. 28, 1917. Report on electric power supply in Great Britain. Waste of coal.

Coal Problem

Corrective Steps for Our Coal Problem (83856). Ills. 2000 w. Elec Wld—Jan. 26, 1918. Serial, 1st part. Critical question of coal supply and cost; suggestions.

Review of the Coal Situation of the World (83864 D). George S. Rice. 5500 w. A I M E, Bul—Jan., 1918. The resources, production, consumption, exports and imports, etc.

Coal Saving

A Talk to Firemen on Saving Coal (83828). Charles H. Bromley. 2500 w. Power—Jan. 29, 1918. From lecture at Baltimore. Most important way of getting the most out of coal.

Coal Shortage

Facing the Fact of Coal Shortage (83684). 1500 w. Elec Wld—Jan. 19, 1918. Conditions of supply serious for central stations.

Why and Wherefore of the Coal Shortage (83476). J. D. A. Morrow. 2800 w. Cl Age—Jan. 5, 1918. Lack of transportation the primary cause. Also discusses features of the situation.

Coal Trade

Market Conditions in New England in 1917 (83822). G. G. Wolkins. 6000 w. Cl Age—Jan. 26, 1918. Reviews the general features affecting the coal trade.

Philadelphia Coal Trade in 1917 (83717). W. D. Hammer. 5000 w. Cl Age—Jan. 19, 1918. Demands not satisfied and margins of profits small.

St. Louis Coal Trade in 1917 (83821). E. J. Wallace. 2500 w. Cl Age—Jan. 26, 1918. Review.

The Coal Trade of 1917 (83751 A). 29500 w. Colly Gdn—Jan. 4, 1918. Review by districts and by methods of trade in Great Britain.

The New York Coal Trade in 1917 (83716). R. W. Morris. 3500 w. Cl Age—Jan. 19, 1918. Many hardships, uncertainties and disappointments. Bunker coal very scarce.

The 1917 Coal Trade of the Northwest (83713). W. L. Kidston. 3500 w. Cl Age—Jan. 19, 1918. Active year—the supply seldom meeting the demand.

Coal Waste

The Use of Culm and Other Waste Materials from Coal-Washing Plants for Other Purposes (83596 A). John B. C. Kershaw. 4000 w. Met & Chem Eng—Jan. 1, 1918. Reviews progress in utilization of low-grade fuels for power purposes.

Coke-Ovens

Power Plant Installations for By-product Coke Oven Plants (83894 A). George B. Evans. 2500 w. E Cb St L, Jl—Nov.-Dec., 1917. Describes installation in St. Louis plant.

Saline Corrosion of Coke Oven Walls (83749 A). H. Schwenke, in *Glückauf.* Ills. 1500 w. Colly Gdn—Dec. 28, 1917. Methods of prolonging the life of oven linings, and repairing them.

Constituents

The Oxidizable Constituents of Coal (83841 N). J. Ivon Graham and James Hill, with discussion. Ills. 27 pp. Instn Min Engrs, Trans—Dec., 1917. Investigations.

Fuel

Coaling Plants and Fuel (83340 A). W. T. Krausch, with discussion. 9500 w. West Ry Cb, Pro—Nov. 19, 1917. Main features controlling design of plants, fuel economy, etc.

Fuel Conservation (83955 D). I. Economy in Fuel. Perry West. II. Conservation of Fuel. William M. MacKay. 2000 w. Am Soc Ht & Vt Engrs, Jl—Jan., 1918. Ways and means of conserving the coal supply.

Fuel Consumption Control by the Government (83720). J. W. Henderson. 4000 w. Power—Jan. 22, 1918. Proposes that the government assume absolute control of coal and its distribution and consumption.

Output and Value of Fuel in 1916 (83752 A). 1500 w. Colly Gdn—Jan. 4, 1918. From general report on mines and quarries, edited by W. Walker.

The Fuel Problem (83329 A). L. P. Breckenridge. 1200 w. A S M E, Jl—Jan., 1918. Coal production, distribution and use.

Fuel Conservation

Bonus System for the Saving of Coal (83480). Walter N. Polakov. 3000 w. Elec Wld—Jan. 5, 1918. Task-setting plan results in improved economy.

Fuel Conservation (83926). 2600 w. Times Engng Supp—Nov. 30, 1917. Abstract of paper by J. B. C. Kershaw before Liverpool Engng Soc. Use of low-grade fuels, such as coke-breeze, culm, etc.

Fuel Economy

Work of the New Orleans Fuel Administration Committee (83830). Leo S. Weil. 2000 w. Power—Jan. 29, 1918. Work to conserve the coal supply.

The New Haven Saves a Million Dollars in Fuel (83817). From a report by George W. Wilden. 1800 w. Ry Age—Jan. 25, 1918. Marked economies effected by supervision of locomotives.

Illinois

Southern Illinois in 1917 (83715). E. J. Wallace. 3000 w. Cl Age—Jan. 19, 1918. In spite of many labor troubles the year was prosperous.

Lignites

Carbonizing and Briquetting of Lignites (83959 N). W. J. Dick. 20 pp. Com. of Conservation, Canada—1917. The economic possibilities.

Middle West

Market Conditions in Middle West in 1917 (83718). O. M. Burnett. 3000 w. Cl Age—Jan. 19, 1918. Continuous coal shortage; labor troubles; inadequate transportation, etc.

Mine Engineering

Efficiency Engineering for Coal Mines (83567). C. H. Elsom. 3500 w. Cl Age—Jan. 12, 1918. Value of specialization in engineering.

Mine Power

An Up-to-Date Coal Mine Power Plant (83566). Dever C. Ashmead. Ills. 2000 w. Cl Age—Jan. 12, 1918. Serial, 1st part. Details of construction of a new plant at Clymer, Penn.

Mining Methods

The Working of Seams Having Frail Roofs (83768 A). John W. Case. Ills. 3000 w. Ir & Cl Trds Rev—Dec. 28, 1917. Timbering and best methods are discussed.

Production

Activities in Different Coal-Producing States in 1917 (83711). 20 pp. Cl Age—Jan. 19, 1918. Coal-mine inspectors reports of the various states.

Safety Lamps

Lighting Safety Lamps by Electrical Ignition (83748 A). L. Fokes. Ills. 2500 w. Colly Gdn—Dec. 21, 1917. Details of accumulators and sparking coil method, and of the magneto-generator lighters.

Sampling

Directions for Sampling Coal for Shipment or Delivery (83647). George S. Pope. Ils. 10 pp. U S Bur Mines—Tech paper 133. Instructions regarding hand methods of sampling in the field.

Signaling

Block Signal System for Coal Mines (83568). Frank Huskinson. Ills. 2000 w. Cl Age—Jan. 12, 1918. Details of the automatic system and its advantages.

Spontaneous Ignition

Coal Stack Fire Risks (83739 A). E. B. Pausey. 3000 w. Elec Rev—Dec. 28, 1917. Dangers from spontaneous ignition, the causes, and means of storing coal with a minimum of danger.

Storage

Anthracite and Bituminous Coal Storage (83475). Horace Goldstein. Ills. 2000 w. Cl Age—Jan. 5, 1918. Tells how and where to stock the two kinds of fuel.

Testing

Some Notes on Coal Testing (83742 A). G. W. Stubbings. 2000 w. Elec Rev—Jan. 4, 1918. Directions for sampling and determining the calorific value.

Utah

Coal Mining in Utah in 1917 (83820). A. C. Watts. Ills. 6000 w. Cl Age—Jan, 26, 1918. Reviews this industry for the year.

GEOLOGY

Antarctic

Antarctic Geology (83834 A). Griffith Taylor. Map & Ills. 5500 w. Min Mag—Dec., 1917. Describes geology of part of South Victoria Land and gives information relating to coal deposits.

Oklahoma

Geologic Structure in the Cushing Oil and Gas Field, Oklahoma (83640 N). Carl H. Beal. Ills. & Maps. 55 pp. U S Geol Surv—Bul 658. Aims at preventing economic waste in the production of oil.

Ore Deposits

Pressure in the Formation of Ore Deposits (83880). Stephen Taber. Ills. 2500 w. Min & Sci Pr—Jan. 26, 1918. Crystal pressure in forming vein-space in deposition of minerals.

IRON AND STEEL

Blast Furnaces

Slag Viscosity Tables for Blast Furnace Work (83876 D). A. L. Field and P. H. Royster. Abstract of Tech. paper 187 of U S Bur Mines. 2000 w. A I M E—Dec., 1917. Purpose and scope of slag viscosity tables, their use, etc.

Temperature-Viscosity Relations in the Ternary System $CaO-Al_2-O_3-SiO_2$ (83875 D). A. L. Field and P. H. Royster. Abstract of Tech. paper 189, of U. S. Bur. of Mines. 2500 w. A I M E—Dec., 1917 General features of experimental work and conclusions.

Construction

New Iron and Steel Works Construction (83449 D). 12 pp. Iron Age—Jan. 3, 1918. (Special No.) Open-hearth steel capacity completed last year 4,326,500 tons—that now building represents 1,645,000 tons.

Electric Furnaces

The Booth-Hall Electric Steel Furnace (83443 D. Ills. 2500 w. Iron Age—Jan. 3, 1918. (Special No.) New type operating at the plant of the Midland Electric Steel Co., Terre Haute, Ind.

Electrometallurgy

The Status of the Electric Steel Industry (83448 D). 2500 w. Iron Age—Jan. 3, 1918. (Special No.) Progress since 1910. United States foremost in output.

Engineering Industries

The Iron, Steel, and Engineering Industries in 1917 (83762 A). 5000 w. Engr—Jan. 4, 1918. Serial, 1st part. Annual review of industries in Great Britain.

Fuel-Saving

Newcastle Local Station: Chairman's Address (83611 N). A. H. W. Marshall. 5800 w. Instn E E, Jl—Dec., 1917. Electricity, and its bearing on fuel-saving in the iron and steel trades.

Iron Ore

Shortage of Supply of Non-Phosphoric Iron Ore (83910). W. G. Fearnsides. Ills. 2000 w. Nature—Nov. 22, 1917. Abstract of Howard Lectures before Royal Society of Arts.

Iron Trade

Reviews of Iron, Steel and Other Metals in 1917 (83446 D). 18 pp. Iron Age—Jan. 3, 1918. (Special No.) Reviews by different writers of the developments in important markets. Production, prices, wages, etc.

British Iron and Steel Trades in 1917 (83537 A). L. H. Quin. 1800 w. Iron Age—Jan. 10, 1918. Strictest government control throughout the year.

The Iron and Steel Trade in 1917 (83772 A). 4500 w. N & Cl Trds Rev—Jan. 4, 1918. District reviews.

Manganese

The Determination of Manganese in Steel in the Presence of Chromium and Vanadium by Electrometric Titration (83607 B). G. L. Kelley, M. G. Spencer, C. B. Illingworth, and T. Gray. 4000 w. Jl Ind & Eng Chem—Jan., 1918. Shows a method that does not require special skill.

Metallurgy

Phases of Iron and Steel Metallurgy in 1917 (83447 D). J. E. Johnson, Jr. 7000 w. Iron Age—Jan. 3, 1918. Special No.) Operating difficulties were a spur to new methods.

New Plant

New Steel and Wire Plant (83442 D). Ills. 1800 w. Iron Age—Jan. 3, 1918. (Special No.) Plant of Keystone Steel & Wire Co., near Peoria, Ill.

Pig Iron

The Cost of Electric Pig Iron Production in North Sweden (83370 A). 2000 w. Engng—Dec. 14, 1917. Considers the fuel for the reduction of the ore, the ore, and the power.

Plate Mill

Build Hundred and Ten Inch Plate Mill in Six Months (83451). Ills. 2000 w. Eng News-Rec—Jan. 3, 1918. Details of construction of "Liberty Mill" at the Homestead Works, explaining conditions.

The Liberty Mill (83550 A). Ills. 200 w. Int Mar Eng—Jan., 1918. 110-inch plate mill for rolling ship plates for emergency fleet.

The Liberty Mill of the Carnegie Steel Co. (83436 D). Ills. 2500 w. Iron Age—Jan. 3, 1918. (Special No.) A 16000-ton monthly capacity plate mill built in six months at Munhall, Pa.

Spiegeleisen

Spiegeleisen in Place of Ferromanganese (83441 D). Edwin F. Cone. 2500 w. Iron Age—Jan. 3, 1918. (Special No.) Experience of some American steel makers.

Steel

The Effect of the Presence of a Small Amount of Copper in Medium-carbon Steel (83867 D). Carle R. Hayward, and Arch B. Johnston. 1800 w. A I M E, Bul—Jan., 1918. Investigation to obtain data on the mechanical properties.

Sudbury Ores

Nickel-Copper Steel Direct from Ludbery Ores (83623). F. H. Mason. 1200 w. Min & Sci Pr—Jan. 12, 1918. Analyses of ore and steels; methods and tests.

Tin Plate

The Manufacture of Tin Plate (83439 D). Clement F. Pappleton. Ills. 6500 w. Iron Age—Jan. 3, 1918. (Special No.) Equipment of the modern plant.

MINE OPERATION

Asbestos

Asbestos Mining in Tasmania (83631 A). Hartwell Conder. Ills. 2000 w. Aust Min Stand—Dec. 6, 1917. Describes this industry and the outlook.

Butte

Mining at Butte (83488). Ben F. Evans. Ills. 2200 w. Min & Sci Pr—Jan. 5, 1918. Labor troubles; November output of the Anaconda; influence of prices of copper and silver.

Chronology

Mining Chronology of 1917 (83824). R. Dawson Hall. 2500 w. Cl Age—Jan. 26, 1918. Important events.

Drill Bits

Relative Merits of Carr and Cross Bits as Disclosed by Drilling Tests (83861). 700 w. Eng & Min Jl—Jan. 26, 1918. Reviews development of various classes of bits and conditions under which special types may be employed.

Elevators

Otis Passenger Elevator at Inspiration Shaft (83874 D). C. E. Arnold. Ills. 1200 w. A I M E—Dec., 1917. Amplifies description given by H. Kenyon Burch in a recent paper.

Fires

Measures for Controlling Fires at the Copper Queen Mine (83868 D). Gerald Sherman. Ills. 1200 w. A I M E, Bul—Jan., 1918. Notes on preparations to check fire and facilitate the escape of workmen.

Gasoline Engines

Suggestions for the Safe Operation of Gasoline Engines in Mines (83648). R. H. Kudlich and Edwin Higgins. Ills. 15 pp. U S Bur Mines—Tech paper 174. Deals especially with precautions that should be taken to prevent mine fires or explosions, or air pollution.

Hydraulic Mining

Syphoning Gravel (83830 N). J. Jervis Garrard. Ills. 2000 w. Instn Min & Met, Bul. 150—Dec. 13, 1917. Method of hydraulicking and elevating by means of a syphon.

Methods

American Notes (83842 N) Samuel Dean, with discussion. 27 pp. Instn Min Engrs, Trans—Dec., 1917. Methods of increasing production, comparisons; management, etc.

Branch Raise System at the Ruth Mine, Nevada Consolidated Copper Co. (83871 D). Walter S. Larsh. Ills. 1500 w. A I M E, Bul—Jan., 1918. Details of development.

Mining

Mining in the North-West (83726). Francis A. Thomson. 1500 w. Min & Sci Pr—Jan. 19, 1918. Labor supply; smelting and transportation facilities.

Mining in 1917

Mining in Utah in 1917. Edward R. Zalinski; in Colorado. George E. Collins; in Idaho. Robert N. Bell (83734). 8 pp. Eng & Min Jl—Jan. 19, 1918. Reviews.

Quarrying

War Time Quarrying in the High Peak (83745 A). Ills. 2500 w. Quarry —Jan., 1918. Quarries of the Buxton Lime Firms worked by women.

Russia

Mining Laws for Russia (83489). Horace V. Winchell. 1500 w. Min & Sci Pr—Jan. 5, 1918. General principles suggested to Ministry of Commerce & Industry.

Shafts

New Shaft at Kirkby Colliery (83639 A). Ills. 1800 w. Ir & Cl Tds Rev—Dec. 31, 1917. Detailed description.

Ventilation

Canvas Tubing for Mine Ventilation (83870 D). L. D. Frink. Ills. 2500 w. A I M E, Bul—Jan., 1918. Explains its use at Butte, Mont.

MINES AND DISTRICTS

Alaska

Mining Developments and Water-Power Investigations in South-eastern Alaska (83641 N). Theodore Chapin, H. M. Eakin, and G. H. Canfield. Maps. 90 pp. U S Geol Surv—Bul 662-B. Account of mining operations and water-power investigations.

Arizona

Gold, Silver, Copper, Lead and Zinc in Arizona in 1916 (83650 N). V. C. Heikes. 37 pp. U S Geol Surv, I:10—Dec. 21, 1917. Mines report of production by counties.

British Columbia

Summary Review of Mining in British Columbia During 1917 (83891 N). E. Jacobs. 1500 w. Can Min Inst, Bul —Jan., 1918.

Colorado

Colorado Metal Production in 1917 (83624). Maps. 1500 w. Min & Sci Pr—Jan. 12, 1918. Output of gold, silver, copper, lead and zinc.

Dargalong

Dargolong Silver-Lead Mines, near Chillagoe, North Queensland (83636 N). Lionel C. Ball. Ills. 8000 w. Qnsd Gov Min Jl—Dec., 1917. History, production, geology, holdings, etc.

Idaho

Mining Districts of Northern Idaho (83879). E. K. Soper. Map. 6000 w. Min & Sci Pr—Jan. 26, 1918. Geology the Cœur d'Alene region.

MINOR MINERALS

Bauxite

Bauxite in the Coastal Plain of Georgia (83486). Excerpts from report of H. K. Shearer. 4000 w. Eng & Min Jl—Jan. 5, 1918. Describes the geology, character, size and distribution, the methods of mining and treatment.

Carbonate Ores

Zinc Carbonate and Related Copper Carbonate Ores at Ophir, Utah (83649 N). G. F. Loughlin. Ills. 14 pp. U S Geol Surv, Bul 690A—Dec. 24, 1917. Occurrence, mineralogy, deposition, etc.

Gypsum

The Gyspum and Natural Whiting Deposits of Yorke Peninsula, South Australia (83634 N). L. J. Winton. 1200 w. Chem Eng & Min Rev—Nov. 5, 1917. Report for half-year ending June 30, 1917.

Gypsum Products, Their Preparation and Uses (83793 A). R. W. Stone. Ills. & Map. 53 pp. U S Bur Mines—Tech paper 155. Methods of mining or quarrying; equipment and operation of plants for reducing the crude rock to market products.

Manganese

Manganese in West Africa (83835 A). Stanley H. Ford. Ills. 1000 w. Min Mag—Dec., 1917. Recently discovered deposits now supplying English steel makers.

Undeveloped Manganese Ore Tracts in Shenandoah Valley, Virginia (83343). 1000 w. Mfrs Rec—Jan. 3, 1918. Information concerning deposits of promise.

Marble

On the Occurence of White Marble at South Ulam, Rockhampton District (83635 N). E. C. Saint-Smith. Ills. 4500 w. Qnsd Gov Min Jl—Dec., 1917. Unlimited supplies of commercial quality in Queensland.

Potash

A Neglected Chemical Reaction and an Available Source of Potash (83838 N). E. A. Asheroft. Maps. 7500 w. Instn Min & Met, Bul. 159—Dec. 13, 1917. Describes research work with feldspathic minerals and salts.

Bibliography on the Extraction of Potash from Complex Mineral Silicates, Such as Feldspar, Leucite and Glauconite (Greensland Marl) (83597 A). E. C. Buck. 5 pp. Met & Chem Eng—Jan. 1, 1918. Serial 1st part. Useful in research work.

Enormous Deposits of Potash on Which America May Draw (83668). 2200 w. Mfrs Rec—Jan. 17, 1918. Possibilities of Searles Lake, in California.

Italian Leucitic Lavas as a Source of Potash (83598 A). Henry S. Washington. 7000 w. Met & Chem Eng—Jan. 15, 1918. Possible source of enormous supplies of potash including estimates of quantity.

Gisements De Potasse Nouveaux (83901 B). P. Sallior. Ills. 1800 w. La Nature—Nov. 24, 1917. New potash deposits in Alsace of immense value to Germany.

Recovery of Potash from Greensand (83606 B). H. W. Charlton. Read before Am. Soc. 2500 w. Jl Ind & Eng Chem—Jan., 1918. Details of a process of obtaining caustic potash and converting the residue into a material of value.

Rare-Earth Minerals

Zirconium and Rare-Earth Minerals in 1916 (83651 N). Waldemar T. Schaller. 10 pp. U S Geol Surv, II:25—Dec. 22, 1917. Occurrence, uses, production, etc.

Salt

La Consommation Et La Production Du Sel (83937 B). N. Flamel. 3000 w. Le Génie Civil—Nov. 17, 1917. Serial. 1st part. Various methods of salt production and manufacture.

Tin

Tin Deposits of Irish Creek, Virginia (83484). Henry G. Ferguson. Sketch maps. 2200 w. Eng & Min Jl—Jan. 5, 1918. Report of tin veins in Rockbridge County and the prospect of successful development.

OIL AND GAS

Cracking Processes

The Rittman and other Cracking Proccesses (83659 A). H. G. James. 1200 w. West Eng—Jan., 1918. Recent improvements makes possible large increase in production of gasoline.

Gas

Future Gas-Making Practice (83921). 2200 w. Times Engng Supp—Nov. 30, 1917. Effect on the methods employed of the change in standard of calorific power for coal gas in England.

Gasoline

Extraction of Gasoline from Natural Gas as an Industry Allied to Production and Refining of Petroleum (83872 D). Frank P. Peterson. Ills. 4500 w. A I M E—Dec., 1917. Details of important factors.

Illinois

Oil and Gas Fields of Illinois (83860). H. A. Wheeler. Ills. & Map. 2500 w. Eng & Min Jl—Jan. 26, 1918. Occurrences which have made Illinois the second largest producer of high grade oil since 1907.

Oil

Water Surfaces in the Oil Fields (83866 D). Marcel R. Daly. Ills. 2500 w. A I M E, Bul—Jan., 1918. A study of the conditions of equilibrium of the "free surface" of a water body enclosed in a porous medium.

Oil Recovery

Methods for Increasing the Recovery from Oil Sands (83792). J. O. Lewis. Ills. 114 pp. U S Bur Mines—Bul. 148. Principles involved in increasing recovery and methods of extracting more oil.

Oil Supply

An Optimistic View of the Future Supply of Oil (83604 A). I. N. Knapp. Ills. 11 pp. E Cb Phila, Jl—Jan., 1918. Shows that supplies of shale oil to supplement petroleum makes an oil famine improbable.

ORE DRESSING

Concentrator

The Taylor Concentrator for Tin and Lime (83836 A). J. Waring Partington. Ills. 1200 w. Min Mag—Dec., 1917. Particulars of a new table which is giving improved results.

Crushing

Recent Tests of Ball-mill Crushing (83869 D). C. T. Van Winkle. 3000 w. A I M E, Bul—Jan., 1918. Tests of Hardings vs. Marcy mill at Inspiration, etc.

Ore Dressing

East Pool Dressing Practice (83837 A). Flow-sheet. 1500 w. Min Mag—Dec., 1917. Present practice in dressing of Cornish tin—wolfram—arsenic ores.

PRECIOUS METALLURGY

Cyaniding

Precipitation Electrolytique Des Solutions De Cyanure (83936 B). 3000 w. L'Industrie Electrique—Dec. 10, 1917. Methods of electrolytic precipitation of gold, silver and copper from cyanide solutions.

Precipitation

Charcoal Precipitation of Gold-Bearing Cyanide Solutions (83633 N). H. G. Walton. Ills. 1000 w. Chem Eng & Min Rev—Nov. 5, 1917. Report of department of mines, Western Australia, for year 1916.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION

Canada

Raliway Progress in Canada During the Year 1917 (83463 A). J. L. Payne. Ills. 2500 w. Ry Age—Jan. 4, 1918. (Special No.) Roads worked under heavy pressure with shortage of labor.

Collision

Side Collision Between Passenger Trains (83626). Ills. 3500 w. Ry Sig Engr—Jan., 1918. Abstract of report on the wreck at Larmond, Va.

Efficiency

American Railway Efficiency During the War (83462 A). 4500 w. Ry Age—Jan. 4, 1918. (Special No.) Reviews accomplishments and increased service in nine months since U. S. entered conflict.

Government Control

Nation's Railroads Now Under Government Control (83461 A). Also editorial. Photographs. 10000 w. Ry Age—Jan. 4, 1918. (Special No.) Details of new organization. Probable changes.

Government Operation

Director General of Railroads McAdoo on the Job (83541). 4500 w. Ry Age—Jan. 10, 1918. "Freight-moving-week" ordered; demurrage rates increased; passenger service curtailed.

Running the Railroads Under the New Regime (83680). 4500 w. Ry Age—Jan. 18, 1918. Freight moving week; status of the I. C. C. and the State commissions; wages and mail service.

Railroad Problems

Railroad Problems and Conditions Growing Out of the War (83338 A). R. H. Ashton. 3500 w. West Ry Cb, Pro—Nov. 19, 1917. Reviews the work accomplished by railroads in the United States under the War Board.

Signaling

Progress in Railroad Signaling During the Year (83469 A). Ills. 6 pp. Ry Age—Jan. 4, 1918. (Special No.) Marked progress in interlocking.

Review of Signaling in the Past Year (83625). 9 pp. Ry Sig Engr—Jan., 1918. Record of block signals and interlockings completed, under construction, and contemplated.

Signals

Report of Committee X—On Signals and Interlocking (83805 C). Ills. 27 pp. Am Ry Eng Assn, Bul—Nov., 1917.

Terminal Facilities

Increase Engine Terminal Output (83732 A). Articles by F. P. Roesch, E. J. Harrison, F. W. Taylor, John C. Murdock. 2500 w. Ry Mech Engr—Jan., 1918. Suggestions for improving facilities.

Train Control

Maximum Speed Retardation and Rail Conditions as Related to Control of Trains (83549 A). Walter V. Turner. 5000 w. Ry & Loc Eng—Jan., 1918. How to realize the best economy in the control of trains.

Train Handling

Train Handling (83473). G. H. Wood. 2200 w. Ry Rev—Jan. 5, 1918. From *Santa Fe Emp. Mag.* Advocates increased piston travel and careful draw gear inspection.

See also Compensation, Railway Finance, Railroad Securities and Valuation, under Industrial Management, *Finance and Costs;* and Administration Bill, under *Regulation.*

MOTIVE POWER AND EQUIPMENT

Cars

All Wood and Composite Hopper Cars for the Norfolk & Western Railway (83472 A). B. W. Kadel. Ills. 2500 w. Ry Rev—Jan. 5, 1918. Details of two recent designs.

Freight Car Orders in 1917 Reach Low Level (83468 A). Ills. 8 pp. Ry Age—Jan. 4, 1918. (Special No.) Domestic orders lowest since the year 1908.

The Business Box Car (83796 A). W. J. Bohan, with discussion. 10000 w. West Ry Cb, Pro—Dec. 17, 1917. Business of a box car and the relation of its construction.

Design

The Universities and Equipment Development (83731 A). Ills. 3000 w. Ry Mech Engr—Jan., 1918. Value to the designer of scientific investigation.

Draw Gear

Friction Draw Gear (83546 A). Ills. 2500 w. Ry & Loc Eng—Jan., 1918. Capacity of draw gear; difference in give between wooden and steel cars. Tests.

Electric Locomotives

Developments in Electric Locomotives in Italy (83380 A). Ills. 1200 w. Engng—Dec. 14, 1917. Serial. 1st part. Deals with improvements on the electric locomotives of the Italian State Railways.

Mechanical Problems in the Design of Electric Locomotives (83581 A). W. K. McAfee. Ills. 2000 w. Elec Jl—Jan., 1918. Problems relating to tracking qualities, transmission of power from the motors to the rails, and design of motors.

Electrification

Electrification of Railroads as a War Measure (83579 A). F. E. Wynne. Ills. 1800 w. Elec Jl—Jan., 1918. What electrification is capable of doing.

Further Railroad Electrification Important (83520). F .H. Shepard. Ills. 2000 w. Elec Ry Jl—Jan. 5, 1918. Aims to show that electrical equipment gives an effective way of increasing transportation capacity.

Guides

Adjusting the Guides and Crossheads (83548 A). Ills. 1800 w. Ry & Loc Eng—Jan., 1918. Directions for proper adjustment.

Headlights

Locomotive Headlights (83547 A). 2000 w. Ry & Loc Eng—Jan., 1918. Peculiarities of the parobolic curve; the electric headlight; how case and reflector serve their purpose.

Locomotive Performance

Increase Locomotive Operating Efficiency (83727 A). Clement F. Street Ills. 3000 w. Improvements being made with a view to increasing earnings.

Performance of the Mohawk or 4-8-2 Locomotive of the New York Central Railroad (83550 A). Ills 500 w. Ry & Loc Eng—Jan., 1918. Good tractive effort at high speed.

Locomotives

Conversion of Single-Expansion to Compound Engines on French Railways (83385 A). Ills. & Plate. 1000 w. Engr—Dec. 14, 1917. Arrangements adopted.

1917 a Record Breaker in Locomotive Orders (83467 A). 6 pp. Ry Age—Jan. 4, 1918. (Special No.) Orders totaling 7,642 as compared with 5,893 in 1916. Bright prospects for coming year.

Trains

Special Train for the Director-General of Transportation (83767 A). Ills. & Plate. 1000 w. Engr—Jan. 4, 1918. Built by the North-Eastern Ry. Co. of England for the British Director-General and his staff.

PERMANENT WAY AND BUILDINGS

Freight Terminal

New Ocean Freight-Terminal Started on Staten Island (83675). Ills. 1800 w. Eng News-Rec—Jan. 17, 1918.

Snowsheds

Telescope Sections for Latest Timber Snowsheds (83457). Ills. 1000 w. Eng News-Rec—Jan. 3, 1918. Features developed by Southern Pacific Co. in Sierra Nevadas.

Track Elevation

Track Elevation Work of the P. C. C. & St. L. Ry. in Cincinnati (83706). Ills. 1000 w. Ry Rev—Jan. 19, 1918. Details of construction.

Track Stresses

See same heading under Civil Engineering, *Measurement.*

ROADS AND PROJECTS

Alaska

The Government Railroad of Alaska (83318). Theodore Pilger. Ills. & Map. 5000 w. Min & Sci Pr—Dec. 29, 1917. First American railroad built and owned by United States government. Details of development.

Australia

The Australian Trans-Continental Railway from Port Augusta to Kalgoorlie (83755 A). E. A. Box. Ills. 3000 w. Engng—Dec. 28, 1917. History of a great undertaking accomplished under many difficulties.

Baghdad Ry.

The Baghdad Railway and Its Part in the War (83816). Map. 2500 w. Ry Age—Jan. 25, 1918. Mesopotamia campaign has hindered the completion.

Construction

Railway Construction and Operation in the Fighting Zone of France (83679). Extract from lecture by Leslie F. Van Hagan. 1800 w. Eng & Con—Jan. 16, 1918. Describes work of American and Canadian railway regiments in handling troops and supplies at the front.

France

Les Voies De Communication Directes Entre France Et Italie (83902 B). Ills. 1200 w. La Nature—Nov. 24, 1917. Railways and highways between France and Italy. Characteristics and advantages of each.

New Construction

New Railway Construction in Foreign Countries (83464 A). P. Harvey Middleton. 5000 w. Ry Age—Jan. 4, 1918. (Special No.) Projects in South America, Asia, and Africa.

Construction Activities During the Year (83466 A). Ills. & Curves. 8 pp. Ry Age—Jan. 4, 1918. (Special No.) Total mileage of new lines completed in 1917 compares favorably with the two preceding years.

P. R. R.

The New Pennsylvania Entrance Into Indianapolis (83814). Ills. 2500 w. Ry Age—Jan. 25, 1918. Line between Ben Davis and Frankfort, in Indiana, gives complete line between Indianapolis and Chicago.

TRAFFIC

Car Loading

Pennsylvania Lines Specialize in Car Conservation (83818). 2500 w. Ry Age—Jan. 25, 1918. Excellent results from intensive loading.

Coal Movement

Director General McAdoo Speeds Up Coal Movement (83542). Ills. 1500 w. Ry Age—Jan. 10, 1918. Complications of the fuel problem.

Freight Handling

Freight Handling at the Panama Canal (83558 A). Ills. 1500 w. Int Mar Eng—Jan., 1918. Introduction of storage—battery trucks.

Loading

Methods of Locating Lumber in Open Top Cars (83682). Ills. 1000 w. Ry Age—Jan. 18, 1918. Serious waste of equipment and labor due to failure to prevent shifting of lading.

Ore Transportation

All Forces United in Moving Lake Ore (83434 D). F. L. Prentiss. Ills. 1800 w. Iron Age—Jan. 3, 1918. (Specila No.) Change in methods due to war necessities.

MISCELLANY

British Railways

The Future of British Railways (83387 A). 2000 w. Engr—Dec. 14, 1917. Serial. 1st part. The difficulties and how they may be met when Government control terminates.

Canada

The Railway's Part in Developing Western Canada (83539). Ills. 4000 w. Ry Age—Jan. 11, 1918. Methods of the Canadian Pacific in attracting settlers.

Scrap

Scrap Reclamations on the Atchison, Topeka & Santa Fe Ry. (83850). Charles E. Parks. Ills. 2500 w. Ry Rev—Jan. 26, 1918. Serial. 1st part. Résumé of practice in collecting classifying and salvaging waste.

STREET AND ELECTRIC RAILWAYS

Axles

Car Axles—Their Design, Manufacture and Service (84053). Norman Litchfield. Diagrams. 1500 w. Elec Ry Jl—Feb. 2, 1918. Serial, 1st part. Estimating fiber stress is considered.

Cars

How the Pay-As-You-Pass Car Was Developed (83522). Peter Witt. Ills. 2500 w. Elec Ry Jl—Jan. 5, 1918. Explains how the present Cleveland car cuts down boarding and alighting time and insures collection of fares. Possibility of further development.

The Front-Entrance, Center-Exit Car and Higher Schedule Speed (83710). Ills. 2500 w. Elec Ry Jl—Jan. 19, 1918. Experience in several cities favorable.

Economy

Economy and the Railway Man (83798 A). R. E. Danforth. 5500 w. AERA—Dec., 1917. Ways in which operating expenses can be kept down without impairing quality of service.

Electric Railways

Applying Engineering and Selling Principles to Electric Railway Transportation (83521). J. F. Layng. 23 pp. Elec Ry Jl—Jan. 5, 1918. A discussion of the present situation and its connection with the conservation of the nation's resources.

England

Traffic Problems in British Cities (83919). 2000 w. Times Engng Supp—Nov. 30, 1917. Special problems in different cities; traffic density as compared with those in other cities of the world.

Maintenance

Railway Equipment Maintenance (83797 A). John S. Dean. 1000 w. AERA—Dec., 1917. Serial, 1st part. The present article deals with organizations.

Montreal

Electric Railway Power at Montreal (83563). Ills. 2000 w. Elec Ry Jl—Jan. 12, 1918. Principal dependence is on hydraulic plants. Explains general plan.

Rail Return

Sur Le Retour Du Courant Par Les Rails (83933 D). E. Brylinski and G. Girousse. 12000 w. Bull Soc Internationalle Des Électriciens—Nov., 1917. Mathematical treatment of return current in tramway rails. Voltage, location of feeders, etc.

Rail Wear

An Early Experimental Study of Rail Wear (83852). R. C. Cram. Ills. 2500 w. Elec Ry Jl—Jan. 26, 1918. First use of electric weld joints, with abstract of paper by A. J. Moxham, read in 1898.

Zone System

Zone System Approved for Holyoke Compnay (83565). 4000 w. Elec Ry Jl—Jan. 12, 1918. Decides that zone system with central 5-cent area is best suited to local situation.

BOOK NOTICES

A MUNICIPAL EXPERIMENT, by Reginald P. Bolton. Size, 5x8 inches; 238 pages. Ills. Price, $1.00 New York: Bureau of Public Service Economics, Inc.

This is a description of the power plant installed in the Hall of Records, New York City. The reasons for using an isolated plant and the results attained with it.

MOTION PICTURE EDUCATION, by Ernest A. Dench. Size, 5x8 inches; 354 pages. Price, $2.00. Cincinnati: The Standard Publishing Company.

A well written exposition of the numerous and varied ways in which education is assisted by the use of films.

EXAMPLES IN BATTERY ENGINEERING, by Prof. F. E. Austin. Size, 4½x7½ inches; 90 pages. Ills. Price, $1.25. Hanover, N. H.: Published by the author.

This is a compact, useful text book similar to the others of the series in electrical engineering by this author, but more detailed in the problems whose application and solution are given.

RESULTS OF MANAGEMENT with Practical Instructions on Machine Building, by William Lodge. Size, 5x8 inches; 140 pages. Price, $1.50. New York: McGraw Hill Book Company, Inc.

PRECISION GRINDING MACHINES, by Thomas R. Shaw. Size, 5½x8½ inches; 214 pages. Ills. Price, $4.50. London: Scott, Greenwood & Company, New York; The Van Nostrand Company.

A book giving detailed descriptions of the latest types of grinding machines and methods of using them.

INTERNAL COMBUSTION ENGINE MANUAL, by F. W. Sterling. Size, 6x9 inches; 168 pages. Ills. Price, $2.00. Washington, D. C.: Pub. R. B. Beresford; fourth edition, 1917.

This book, written by Lieutenant Commander Sterling, of the United States Navy, gives complete descriptions of every type of gasoline and heavy oil engine used in the navy. It is in use at the Naval Reserve Officer School at Annapolis, as well as at the Sheffield Scientific School of Yale.

TELEGRAPH PRACTICE, a Study of Comparative Method, by John Lee. Size, 5x7½ inches; 102 pages. Price, $1.00. London and New York: Longman's Green & Company.

A general review of English and continental methods of telegraph practice, outlining some of the recent systems in use, but giving no details of apparatus or line connection.

INDUSTRIAL MANAGEMENT
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Administration of War Labor Problems

The Department of Labor Is Organized to Provide A Peaceful Process to Redress Industrial Grievances

By Hon. William B. Wilson
Secretary, United States Department of Labor

There has been far too little publicity of an educative kind in regard to labor's relation to the war. In this article Secretary Wilson *states what that relation is, discusses the causes of labor difficulties and unrest, and presents recommendations as to remedies. He also outlines the organization of the Department of Labor, carried out under the direction of President Wilson for the purpose of providing the necessary administration and agencies to handle the national labor problem.*

Hon. William B. Wilson, *in true American fashion, has climbed the ladder from miner, in 1871 to 1898, to the responsible position of Secretary of Labor in the Cabinet of President Wilson since March 5, 1913. During the years 1898 to 1913, he was President of the District Miners' Union, Secretary and Treasurer, National Union of Miners, and member of the Sixtieth and Sixty-second Congress of the United States from the Fifteenth Pennsylvania District.*

In no other war in history has the mechanical inventive and productive genius of man played such a dominating part. Never before has such a combination of brain and muscle been applied to war's stagecraft. War is no longer fought solely by the shock of human bodies against human bodies, or by the impact of missiles against the human frame. But science, human skill, muscular energy and productive capacity play a part never before dreamed of.

We are sending the pick of our young manhood to France, there to uphold the traditions of American arms. From "over there" the story is already beginning to come back telling of their heroism. The honor roll of those who must pay the last great price is lengthening. But not they alone are fighting the battles of democracy. In the mills, factories and workshops of America, beneath the surface of the earth in the mines and quarries, and on the fertile soil of thousands of farms the war is likewise being fought and won. American labor, working tirelessly at its appointed task, is performing a matchless service in winning the war, and without that industrial effort the supreme sacrifice of the boys in sunny France and on the sullen Atlantic would be wholly lost.

In the face of these sacrifices the man or set of men who would traffic in the necessities of the people, or mulct the Government out of excess profits, is a traitor to his country. By the same token, the man or set of men who would stir up strife and dissension in American industries, for no other purpose than to hinder the prosecution of the war or gain some selfish end, should be branded with the traitorous stigma. Our country has no room for either. They should be suppressed by a firm hand.

The Tremendous Demand for Material

The procurement schedules of the buying agencies of the Government are beginning to make us all realize how tremendous an amount of war material and supplies are needed to equip our army and navy. To secure this equipment requires the most perfect organization of our industrial forces at home and the realization of the highest possible standard of efficiency. To reach these ends industrial disputes must be abandoned, at least until the war is over; not through any process of crushing the worker or forcing the employer into submission, but by doing justice to both parties to the controversy and to the public at large.

Work of this kind has been going forward ever since the establishment of the Department of Labor through the offices of its conciliators. Many employers and employees involved in industrial controversies have shown a keen desire to take advantage of this process of redress. Under the organic law creating the department the purpose has been constantly kept in the forground that its field of activities was the fostering of industrial peace on a base of industrial justice. It has been demonstrated over and over again that the intervention of an impartial third party in the person of a conciliator approved by the department, invariably has expedited the settlement of a dispute which had culminated in a strike or lock-out. But the most constructive work is the averting of a threatened strike, thereby avoiding the great losses to both employers and employees that such a conflict involves.

Our greatest difficulty has always been the attitude of mind of the employer and employee. But it is gratifying to be able to state that, to-day, when both realize that our institutions are at stake in the issues of this war, and that sacrifice on the part of every one for the common good is an essential duty, we have not had much difficulty in bringing them together and adjusting their disputes.

The Present Man-Power Situation

But in spite of the satisfactory progress made in redressing industrial grievances during the first year of the war, the conclusion cannot be escaped that the available man power of the nation, serving as the industrial arm in warfare, is not employed to its fullest capacity, nor is it in all cases wisely directed.

The effective conduct of the war is suffering needlessly because of, (a) interruption of work, due to actual or threatened strikes or lock-outs, (b) decrease in efficiency through the "strike on the job," (c) decrease in efficiency due to labor unrest, (d) crowded and uncomfortable housing conditions and inadequate local transportation facilities in congested districts, (e) decrease in efficiency due to dilution of skilled labor, and (f) dislocation of the labor supply.

These conditions are not new in American industry nor are their causes previously unknown. Both conditions and causes have long been familiar to us and for long have remained uncorrected. War has only intensified old derangements by making greater demands upon industry and by affording the occasion for new disturbing factors.

Causes of Labor Difficulties and Unrest

Among the causes of labor difficulties and unrest the following stand out with particular significance in their relation to industrial needs in time of war;

1. Broadly speaking American industry lacks a healthy basis or relationship between the executives and the workmen. The basic reason for this lack is the insistence by employers upon individual dealings with their men. Direct dealings with employees' organizations is the exception instead of the rule in the United States. In the majority of instances there is no joint dealing, and in too many cases employers are in active opposition to labor organizations. This failure to equalize the parties to inevitable industrial contests is the central cause of our difficulties.

There is a commendable spirit throughout the country to correct specific evils, but the leaders of industry must go much further. They must aim for the release of normal feelings among their employees by enabling labor to take its place as a real coöperator in the industrial enterprise. In a word, a conscious attempt must be made to create and develop a new spirit in industry.

2. Far too many of our labor disturbances are due to the lack of disinterested processes which may be utilized to work out a peaceful settlement. Force is too often resorted to as an outlet. We need and have needed some continuous administrative machinery by means of which the inevitable grievances in industry may be easily and quickly disposed of, and not allowed to reach the pressure that brings explosion.

3. On the part of the employer there is widespread lack of knowledge as to labor's feelings and needs; and there is a similar lack of understanding on the part of labor as to the problems of industrial management. These lacks are due primarily to the absence of collective negotiations, as a normal process in working out human relations in industry. In addition to these conditions there is but little realization of the basic fact that the so called "labor problem" demands just as continuous and systematic oversight as the technical and financial aspects of industrial enterprises.

4. In American industry there are certain specific grievances that when long uncorrected entail definite hardship. They serve as symbols of the attitude of employers and thus affect the underlying spirit of labor. Wages and hours of working are, of course, the principal issues. On the whole, wage increases are asked for usually to meet the increased cost of living, and for that reason such demands should be met, considered and adjusted in their relation to economic conditions and causes. The demand for the eight-hour working day is now nation wide and employees look upon it as part of an accepted national policy.

Two other specific grievances are the belief of workers that they are discriminated against because of membership in labor organizations, and the feeling that they are being driven on this or that pretext for increased production.

Remedies for the Correction of Labor Unrest

The statement and study of the underlying causes of labor difficulties and unrest suggest remedies for their correction:

1. To the utmost practical extent all profiteering must be eliminated during the period of war, if we are to establish and maintain the best morale in industry.

2. In modern, large-scale industry the personal relationship between employer and employee has been destroyed, and with it has gone the mutual understanding and coöperation that come from personal contact. It is no longer possible to conduct industry by dealing with employees as individuals. Some form of collective relationship between management and workmen is indispensable. This principle should form an accepted part of the labor policy of the nation.

3. Law depends for its vitality upon continuous, steady enforcement. Instead of waiting for an adjustment after the grievances come to the surface, there is needed a continuous administrative process for the orderly disposition of industrial issues, and the avoidance of an atmosphere of contention and the wastes that accompany disturbances.

4. The eight-hour working day is already an established policy of the country. Experience has proved the justification of its adoption in war time. Provision must, of course, be made for longer hours in cases of emergency, but labor will readily meet this requirement if the misuse of the exception is

guarded against by establishing appropriate overtime payments.

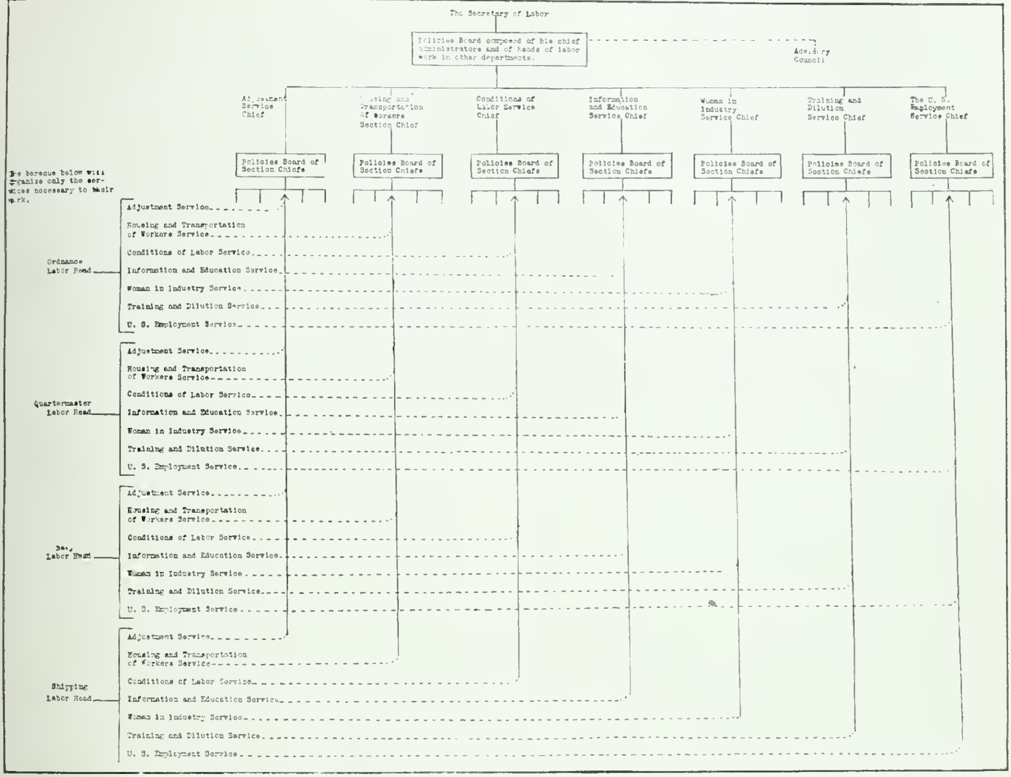
The Secretary of Labor
Policies Board composed of his chief administrators and of heads of labor work in other departments.
Advisory Council
Adjustment Service Chief
Housing and Transportation of Workers Section Chief
Conditions of Labor Service Chief
Information and Education Service Chief
Woman in Industry Service Chief
Training and Dilution Service Chief
The U. S. Employment Service Chief
Policies Board of Section Chiefs
The bureaus below will organize only the services necessary to their work.
Ordnance Labor Board
Quartermaster Labor Board
Navy Labor Board
Shipping Labor Board
Adjustment Service
Housing and Transportation of Workers Service
Conditions of Labor Service
Information and Education Service
Woman in Industry Service
Training and Dilution Service
U. S. Employment Service

CHART SHOWING ORGANIZATION OF THE ADMINISTRATION OF THE NATIONAL LABOR PROGRAM. IT PRESENTS ONLY THOSE PARTS OF THE ORGANIZATION OF THE DEPARTMENT OF LABOR WHICH ARE DIRECTLY CONCERNED WITH WAR ADMINISTRATION OF LABOR MATTERS
This Chart Provides for Centralization of Control in the Department of Labor with Decentralization of Execution by Agencies in Immediate Contact with the problems at issue.

5. A unified direction of labor administration in the United States for the period of the war is an unquestioned essential.

6. Labor should surrender all practices tending to restrict maximum efficiency and output when assured of sound labor conditions and effective means for the just redress of whatever grievances may arise.

7. Uncorrected evils are the greatest provocative to extremist propaganda and their correction would in itself be the most effective counter propaganda. The purposes of the Government and the method it is pursuing should be brought home to the full understanding of labor. Labor has the most at stake in this great war, and will eagerly devote its all if it is only treated with confidence and understanding, subject neither to indulgence nor neglect, but dealt with clearly and openly as a great and integral part of the citizenship of the State.

Labor Department's Organization to Administer War Labor Problems

During the first nine months of the war a number of agencies were dealing with various aspects of the labor problem under the direction of various procurement divisions of the Government. To bring about a centralization and coördination of all these efforts, and to unify the Government's labor program the Council of National Defence submitted to President Wilson a program for war labor administration. This program was approved by the President on January 8, 1918, and the Secretary of Labor was designated to undertake its administration and to provide the following agencies:

1. A means of furnishing an adequate and stable supply of labor to war industries. This to include:

(a) A satisfactory system of labor exchanges.

(b) A satisfactory method and administration of training workers.

(c) An agency for determining priorities of labor demand.

(d) Agencies for the dilution of skilled labor as and when needed.

2. Machinery which will provide for the immediate and equitable adjustment of disputes in accordance with principles to be agreed upon between labor and capital, and without stoppage of work. Such machinery would deal with demands concerning wages, hours, shop conditions, etc.

3. Machinery for safeguarding condition of labor in the production of war essentials. This to include hygiene, safety, woman and child labor.

4. Machinery for safeguarding conditions of living, including housing, transportation, etc.

5. A fact-gathering body to assemble and present data collected through various existing Government agencies or by independent research, to furnish the

information necessary for effective executive action.

6. A publicity and educational division to have the functions of developing a sound public sentiment; securing an exchange of information between departments of labor administration, and promotion in industrtial plants of local machinery, helpful in carrying out the national labor program. Some of the agencies outlined above already existed in part in the Department of Labor. For example, the mediation service, the system of labor exchange and the Bureau of Labor Statistics have been utilized.

Two problems that were faced in reorganizing the activities of the department to carry forward this broad program were the formulating and coördinating of the work of the various existing agencies.

To formulate and declare the principles of the labor policy a planning board was created, of which five members were appointed by the National Industrial Conference Board, five by the American Federation of Labor, and one each by these same agencies to represent the public. This body is advisory only, and is to consider such matters as the following: The basis of wage determination, strikes and lock-outs; piece work prices and price fixing; methods of eliminating improper restriction on output of war material from whatever cause; discrimination against union and non-union men; admission of union agents to industrial plants; methods of promptly adjusting disputes at their source through boards containing equal representations of employees and employers; rights of workmen to organize.

The broad problem of organization within the department was deferred to an advisory council appointed by the secretary. The organization plan developed is shown graphically on the chart, page 267.

The administrative responsibility rests upon a policies board composed of the chief administrators and heads of labor work in other departments. The various functions are assigned to seven sections, each headed by a director. Each section in turn has its own policy board, composed of the section chiefs, and including representatives, so far as they have jurisdiction, of the Ordnance Bureau of the Army, Quartermaster's Department, Navy, and the Shipping Board.

For instance, the United States Employment Section was the first one to organize. Its policy board consists of the director, assistant director, five section chiefs (farm service; woman's information and administration; service reserve; and training of personnel) together with representatives from each of the other governmental departments having labor heads, that is, ordnance, quartermaster, Navy and the Shipping Board.

LOYALTY OF EMPLOYEES

In conclusion, no stronger message can be spoken to employers and industrial managers than the assurance that the overwhelming majority of our laboring population is in no sense disloyal. Before the war labor was filled with the pacific hopes shared in by nearly the entire country. But like other portions of our citizenship labor has fully adjusted itself to the fact revealed by the war in Europe. Its sufferings and its faith are the sufferings and faith of the nation. With the exception of the sacrifices of the men in the Army and Navy, the greatest sacrifices have come from those at the bottom of the industrial ladder. At heart labor is as devoted to the purposes of the Government and the prosecution of the war as any other part of society.

Rates for Annual Depreciation

By Allen F. Brewer

It has been the author's good fortune to have to do with the calculation of percentage rates for annual depreciation for many public-utility properties in New Jersey during the past five years. There are many items, particularly buildings, mechanical and electrical equipment, which are as necessary to an industrial as a public-utility plant and, therefore, certain annual rates of depreciation are given in the accompanying table. Inasmuch as the application of a certain percentage rate of annual depreciation will necessitate an assumption of a theoretical useful life for any item in question, it is here that the engineer must use his best judgment.

The ability to estimate fairly what will be a probable useful life of any piece of apparatus, or any structure, comes only from experience and a thorough knowledge of working conditions. The valuation engineer should be thoroughly conversant with proper and efficient methods of upkeep and maintenance for on such will depend almost entirely the length of time the article will continue in service, barring obsolescence.

ESTIMATED LIVES AND PERCENTAGES FOR ANNUAL DEPRECIATION FOR MECHANICAL PLANT EQUIPMENT

Item and description	Estimated Life years	Per Cent. annual depreciation
Air compressors	25	4
Belts *		
Blowers	20	5
Boiler-feed injectors	25	4
Boiler flues and breeching	40	2.5
Boilers, steam, horizontal water tube	30	3.33
Boilers, steam, vertical water tube	25	4
Boilers, steam, fire tube	25	4
Coal elevator and conveyer	40	2.5
Coal scale	20	5
Condensers, jet	30	3.33
Condensers, surface	33.3	3
Damper regulators	30	3.33
Engines, condensing, cross compound	30	3.33
Engines, condensing, tandem compound	30	3.33
Engines, non-condensing	33.3	3
Engines, reciprocating	33.3	3
Engines, gas	20	5
Electric generators (complete)	30	3.33
Exciters	30	3.33
Feed-water heaters, open tank	30	3.33
Feed-water heaters, horizontal	40	2.5
Feed-water heaters, vertical	40	2.5
Feed-water pumps	30	3.33
Fuel economizers	25	4
Power Plant Buildings **		
Pumps, duplex compound	33.3	3
Pumps, triplex	20	5
Pumps, air	25	4
Stacks, brick (Custodis)	150	.66
Stacks, brick (plain)	100	1
Stacks, steel (self-supporting)	50	2
Stacks, steel (guyed)	30	3.33
Steam piping and valves	30	3.33
Steam gages	33.3	3
Steam traps	20	5
Steam whistles	40	2.5
Steam turbines	33.3	3
Superheaters	30	3.33
Traveling cranes	100	1
Trestles, coal (steel and concrete)	100	1
Trestles, coal (wood)	75	1.33
Water tower or tanks	50	2

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* Belts.—Life of belting is a variable which depends almost entirely on the manner of use and extent of care. Under average conditions eight to ten years would be fair.

** Power plant buildings, brick and reinforced concrete	150	.66
Power plant buildings, brick	100	1
Power plant buildings, frame (heavy)	66.6	1.5
Power plant buildings, frame (light)	50	2

British Shell-Shop Handling Devices

Runways, Conveyors, Elevators and Trucks Help the Production of a Continuous Supply

By George Frederick Zimmer

The lifting and transporting of shells presents a problem far different from that usually met with in handling work in machine shops; the parts are cylindrically formed, uniform in size and present in large numbers. One type of device consists of means to roll or slide the shells along runways, or roller paths. Another type used for the smaller size is a modification of the familiar band conveyor. Much ingenuity has also been spent in devising elevators and trucks.

Mr. George Frederick Zimmer *was associated for 15 years following 1882 with Mr. James Harrison Carter, the well-known pioneer engineer of English roller milling. In 1897 he started practice as a consulting engineer, and at the same time began to market a reciprocating steam conveyor of his own development. He is an extensive writer on the art of mechanical handling of materials and is the author of two books, "The Mechanical Handling of Material," published in 1905, and "The Mechanical Handling and Storing of Material During and After the War," published in 1917.*

THE general management and ingenuity exercised in the erection of the national munition factories in Great Britain, has established a record of what can be done when necessary. The admirable devices to economize man power, whereby unskilled labor, as well as women, can be effectually and economically employed, claim our special attention, and contribute not a little to the insurance of a continuous supply of munitions to the Allied fighting front. A rough idea of the achievements in this direction, and the prodigious dimensions of such works, may be gathered from the following few examples:

A typical howitzer shop, the erection of which was commenced in August, 1915, on a site which was formerly a park, covers an area of 172,000 square feet. The building is of a thoroughly permanent character. It is divided into 15 equal bays and equipped with electrical overhead transporters. Within nine months of the time the builders took possession of the site—that is by May, 1916,—the guaranteed monthly output of howitzers was exceeded, and the methods of mechanical handling for all the materials in this huge shop played, undoubtedly, an important part in this success.

Another factory in the West of England, which was started in 1914 and now covers an area of 270 acres, with an actual floor space of 2,400,000 square feet, has at present a staff of employees numbering 35,000, and the weekly wages bill amounts to £92,000 ($450,000). This factory has been productive since January, 1915, and has yielded many millions of shells.

PROBLEM OF HANDLING PROJECTILES

The handling devices in our machine shops have always been designed and equipped to lift and convey a great variety of objects, varying in weight from say 100 pounds to one ton, but only on the rarest occasions have they been used for handling objects always identically the same, as is the case with projectiles. Now since most metal-working shops are more or less occupied with munition work alongside their own legitimate business, and since huge nationally and privately owned works, whose energies are entirely devoted to the manufacture of shells, have sprung up like mushrooms, the handling devices have naturally undergone modification. Whereas, formerly, the lifting and conveying tackle had to be a sort of man-of-all-work and applicable for all kinds of duty, the munition handling devices of today are specially made tools with gripping and holding devices for all the stages of production from billet to shell, though designed on the same fundamental principle as the old type machines. Moreover, the weight of the shells handled in one factory is practically always the same, so that both the crane and holding device are designed for that specific load and are, therefore, efficient.

There has been a praiseworthy desire throughout to introduce and adopt mechanical handling devices in British munition factories, but such devices have not been pressed into use for the mere sake of doing so, if the handling could be performed with comparative economy without such appliances, particularly where the distance to be conveyed was short or variable.

Since the shell lends itself by virtue of its cylindrical form to being rolled easily by hand, especially on slight inclines, this method is employed in munition works wherever possible. The writer uses the term "comparative economy" advisedly, for though it would be a short-sighted policy to treat munition factories as being of a temporary nature, they are, none the less, installations of that kind where high efficiency in working costs is of less importance than low initial expenditure—while the question of efficiency and large capacity is the principal consideration, ranking far beyond that of cost. No industry could lend itself better to the application of labor-aiding and time-saving appliances. If mechanical handling was not employed in pre-war industries it was often due to the miscellaneous nature of the objects to be handled and the inherent difficulties in handling them. With shells it is altogether different, for they are as much alike as two eggs and their manufacture is the most intensive repetitive work or mass production imaginable. There can be no doubt but that mechanical handling devices are contributing to the attainment of the maximum output from standard machine tools, as they bring a continuous supply of shells to and from the lathes which need therefore never be idle.

RELATION OF HANDLING TIME TO PRODUCTION TIME

For instance, it has been ascertained that the time or cost expended on the handling of 9.2-inch shells is from 12 to 15 per cent. of the total machining time, which later varies from 4 hours and 28 minutes to 5 hours and 57 minuntes; these figures are the net time spent on the work so that the total time, including handling, varies from 4 hours and 38 minutes to 6 hours and 51 minutes, according to the skill of the workers and the efficiency of the handling appliances.

The planning of the general lay-out of a shell factory should depend, to some extent, on the methods chosen for handling, if the best results are to be expected. Yet it does not follow that a shop which has been planned without due consideration to this subject cannot after ward be provided with an efficient handling plant. For instance, independent cranes—one for each lathe or each pair of lathes—which give every satisfaction when handling the small and medium shells have not been found the most favorable solution for handling 12-inch shells, for which purpose the overhead travelling crane is far preferable. It is obvious that the larger shells have to be handled less frequently than the smaller ones, as the operations on the former take longer. It is, therefore, of less moment if a more powerful but slower working device is used for heavier shells, though were it used for smaller sizes it would be somewhat like putting a man on a boy's errand. When contemplating the installation of this latter device it must be taken into consideration that with most overhead handling devices there must necessarily be no driving shafting, pulleys, or driving belts in the way of the path to allow free travel across the bay from lathe center to lathe center of the machine tools on either side.

Two Methods of Handling

The handling of such munitions as shells in course of manufacture may be divided, for the sake of convenience, into two different methods:

1. Conveying the objects while supported from below.
2. Conveying them while suspended from above.

This latter method is not only for conveying, but also for lifting and lowering at the same time.

The first method is obviously more suitable for handling the smaller shells and may be found in its simplest form with scarcely any mechanical applications, the shells being simply slid along, or, by making use of the cylindrical form of the shells, rolled along on some simply devised path. The same system, when used in its highest development, consists in the employment of roller runways in which the shells travel nose foremost over a path or bed of rollers. These appliances may be automatic, either through gravity by giving the path a sufficient incline, or by the application of a simple endless chain drive with push bars to convey the shells along on a level roller path. Other types of elevators, "jack" and other special shell trucks, as well as accumulator trucks, belong to this section.

The second method presents a more complex problem and though applied to small shells is more particularly employed for handling medium and large sizes. It is hopeless to attempt any kind of classification of such appliances which would be more or less arbitrary. Any grouping, moreover, would be useless as, if it applied to shops with an extensive turnover, it would not suit small establishments whether they turn out large or small shells, as they would choose an appliance of the type easiest to obtain. The overhead traveling cranes of machine shops which are now converted into shell factories are naturally used for whatever size shells are manufactured.

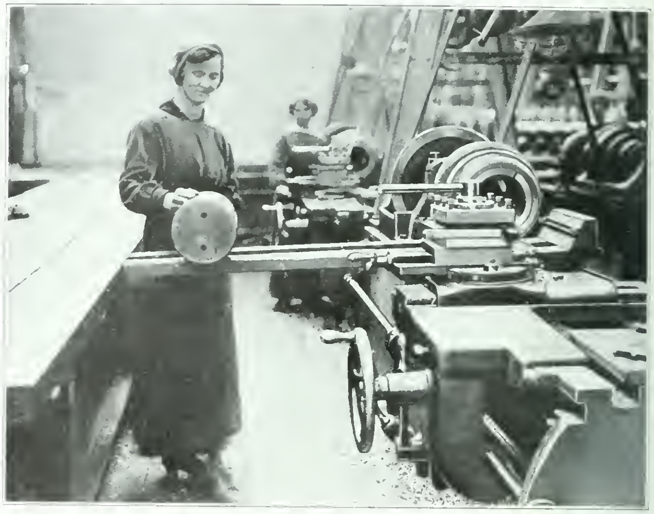

FIG. 1. ROLLING BENCH AND HINGED BRIDGE TO MACHINE

Handling Appliances for Conveying Objects Supported From Below

As already hinted, the simplest expedient for handling shells is to roll them along on what are called "rolling benches," a method in use in quite a number of factories. Sometimes they are rolled on the bare bench and sometimes on two wooden rails; the latter arrangement is preferable. As a general rule this appliance consists of a series of wooden benches which are from 3 feet to 3 feet 6 inches high and 2 feet wide.[1] Their exact height coincides with the height of the machine tool, and the shells are rolled on these benches from one machine to the next. Between these rolling benches and the line of machine tools is a space of a few feet in which the attendant stands. Hinged flaps which bridge this space, see Figures 1 and 2, are attached to the rolling bench. By this means the shells are rolled from the bench to their position in the machine. After a shell has been gripped in the chuck this hinged flap is pushed back clear of the machine.

This system is the simplest one employed in Great Britain for moving shells from place to place and, of

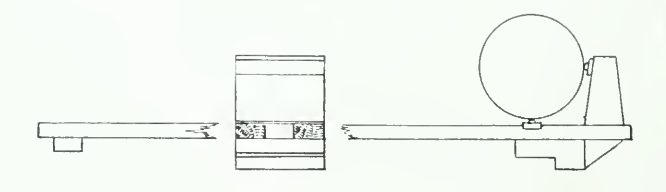

FIG. 2. HINGED BRIDGE ATTACHED TO ROLLING BENCH

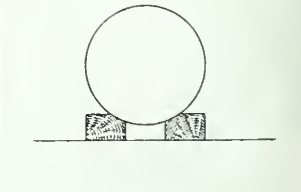

FIG. 3. DETAIL OF ROLLING BENCH TRACK

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[1] In the description of an 8-inch shell factory which follows more reference is made to this arrangement.

course, involves no lifting tackle after the shell has once been placed on the bench level on which it more or less remains throughout its manufacture. Crude as this system may appear it has distinct advantages as it permit the inspection of the shells to be carried out on the bench immmediately one operation is finished, or after a small accumulation has collected. The shells are not rolled to the next machine for a further operation until after this inspection.

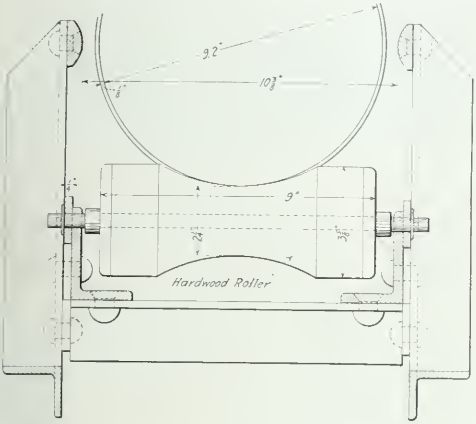


FIG. 4. GRAVITY ROLLER CONVEYOR FOR 9.2 IN. HOWITZER SHELLS

It will be seen from these requirements that a mechanical device is hardly applicable since it would have to work intermittently, at varying intervals and be used for varying distances. This alternating of operation and inspection is carried on until the shell is finally completed.

When transporting the shells from machine to machine, or more particularly when conveying them from one shop to another, or to and from the shell examiners, frequent use is made of gravity and inclined planes on which the friction has been reduced either by lubrication or by a roller path.

The simplest form of track will best be understood from Figure 3. Two wooden battens or rails about two inches high, with the inner edges chamfered off, are screwed to a bench a suitable distance apart to fit the size of shell to be handled, these rails are well greased and the shells are placed on them nose foremost and pushed along. This method is more particularly employed for finished shells in bond-rooms and stores.

The roller runways or gravity conveyors are very well known and hardly require description. However, when they are employed for handling shells which have a tendency to roll off sideways some provision has to be made to keep them centrally on their prepared path. Such provision is made in one of two ways: either the rails between which the rollers are assembled are sufficiently wide to form a guard rail and thus prevent the shell from running off, or the rollers are turned slightly concave. Figure 4 represents a roller runway of W. & C. Pantin's manufacture, in which the hardwood rollers are not only turned concave, but which has at the same time guard rails reaching up to the centre of the 9.2-inch shells to make absolutely sure that they will keep their path.

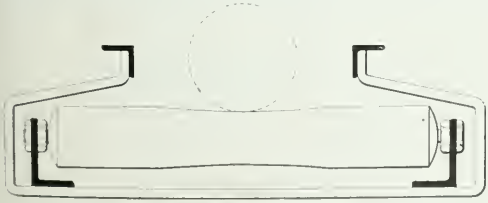


FIG. 5. ALVEY-FERGUSON CO. ROLLER CONVEYOR

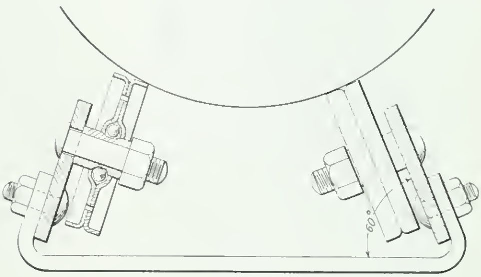


FIG. 6. CROSS SECTION OF GRAVITY WHEEL CARRIER FOR 3 TO 7 INCH SHELLS

A similar appliance shown in Figure 5, made by the Alvey-Ferguson Company (Inc.) consists of much longer rollers and the actual path of the projectile is determined by two steel angles. Ordinary gravity runways are also employed for the conveyance of cases containing munitions to a store or dump from a landing or unloading stage or else in the contrary direction. Miles of these are in use, not only in the munition factories, but also on all the fighting fronts for accumulating and distributing munitions.

When roller runways are used in machine shops a double run is generally employed and installed at the back of the operator and at about the same level as the centre of the lathe. A short overhead cross runway with an H-beam track and travelling chain block, is used to transport a shell from the roller runway to the lathe instead of the wooden bridge described above. As mentioned, the roller runway is in duplicate to serve more than one set of lathes. All shells arrive on the same runway at the back of the operators who are engaged on the same kind of work, and when finished they are placed by them on the second runway to travel to those workers who perform the next operation.

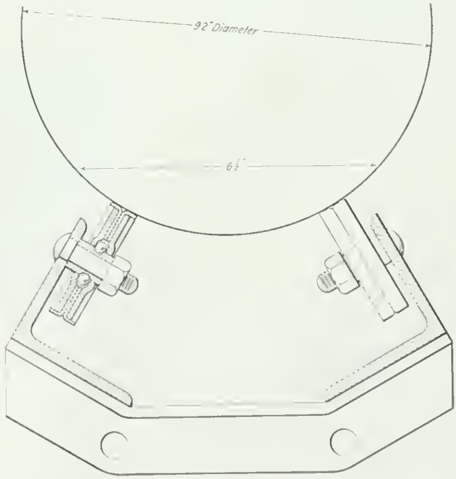


FIG. 7. CROSS SECTION OF WHEEL CONVEYOR FOR 9.2 INCH SHELLS

When runways are used for this class of work in a machine shop they are erected level as the shells are easily pushed along by hand for short distances and only when they are used for rough forgings is it advisable to give them a slight incline to facilitate moving, or even sufficient pitch for them to proceed by gravity.

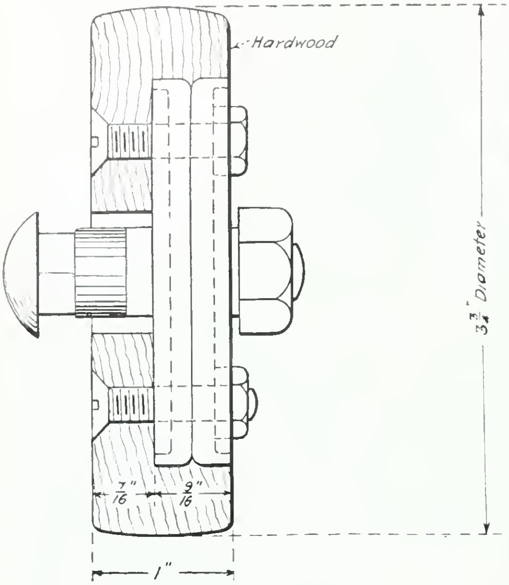


FIG. 8. WOODEN CAPS FITTED TO CONVEYOR WHEELS TO PREVENT DAMAGE TO COPPER SHELL BANDS

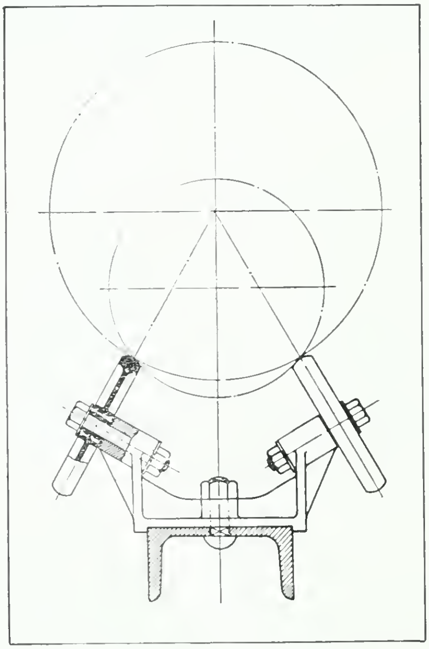


FIG. 9. WHEELED RUNWAY ATTACHED TO A CHANNEL GIRDER

Some managers prefer to erect the runways at the floor level instead of having them on benches, particularly when travelling chain blocks have been installed, as in that case lifting the shells a little higher is not of much consequence. Sometimes they are trundled from rolling benches or runways on portable shell trucks, the rolling bench, shell truck and center of lathe being at the same height.

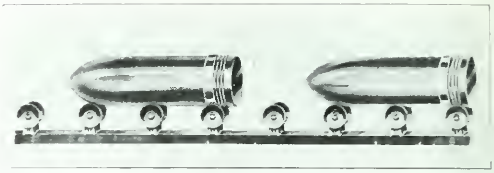


FIG. 10. WHEELED RUNWAY WITH TWO 9.2 INCH SHELLS

Another method of handling shells is by gravity wheel carriers. Figures 6 and 7 show two examples of these, the former being of an earlier type. They are now generally made according to the latter. These illustrations practically explain themselves, as the principle is the same as that of the roller runway. These conveyors are made by Pantin. Figure 8 shows the application of a hardwood roller to cover the original steel rollers, which increases their diameter to 3¾-inch. These wooden coverings are made of steamed beech and are used for handling banded shells. Before the banding process the bare steel wheels are used.

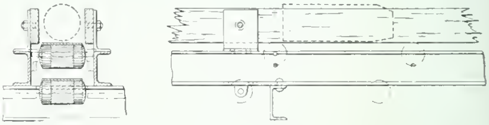


FIG. 11. DETAILS OF BAND CONVEYOR FOR SHELLS

A similar runway attached to a channel girder is made by Rownson Drew & Clydesdale, Ltd., and is illustrated in Figure 9. It is used for shells from 6 to 9.2-inch. When used for shells in course of manufacture, plain steel wheels are also employed, and for banded shells they are tired with rubber. These conveyors, when used on an incline to run by gravity, are generally mounted at a slope of 4 per cent. at which the shells run at a speed of about 60 feet per minute. For

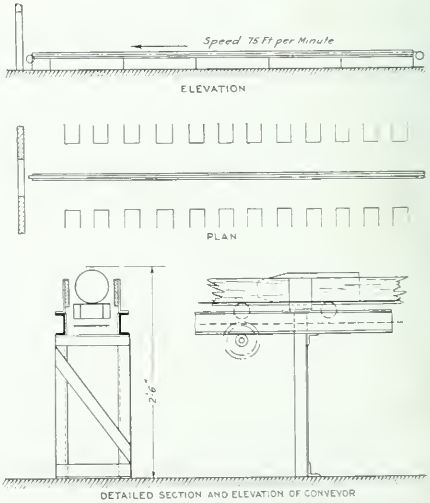


FIG. 12. ARRANGEMENT OF BAND CONVEYOR FOR SHELLS

banded shells the incline has to be from 7 to 7½ per cent. Figure 10 shows a portion of this conveyor with two 9.2-inch shells.

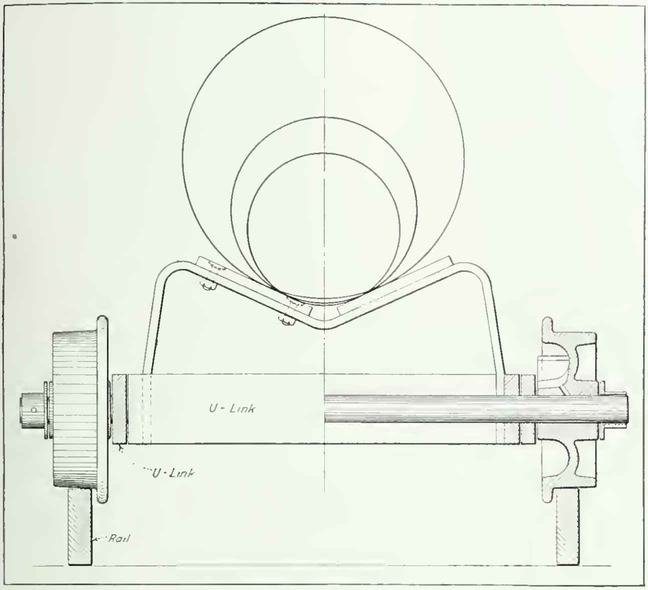


FIG. 13. DETAIL OF CHAIN FOR BENNIS SHELL CONVEYOR

With regard to the band conveyor as a shell carrier, we must realize that this type is undoubtedly at its best when dealing with a continuous load of bulk material, for the intermittent handling of heavy individual loads the band has to be supported so frequently by idlers that it almost assumes the characteristics of a roller runway with an endless band running over it. Thus the handling problem for shells is not solved in the best and most economical way by the adoption of the band conveyor, yet it has some good features and is frequently used in British munition works for the smaller sizes; while for handling shell cases it is most suitable as then none of the above objections obtain.

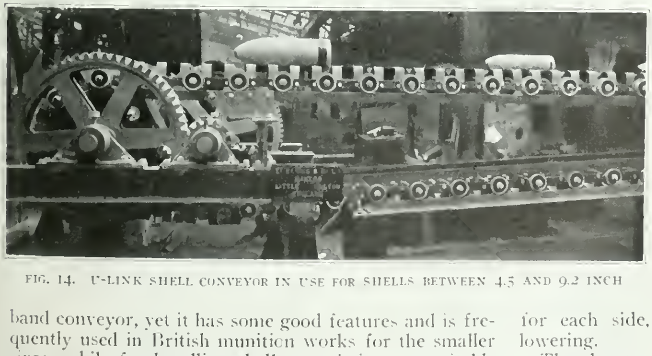


FIG. 14. U-LINK SHELL CONVEYOR IN USE FOR SHELLS BETWEEN 4.5 AND 9.2 INCH

When using band conveyors for the smaller projectiles up to 18-pounder shells it almost suggests itself to employ a troughed band, but such conveyors have proved to be unsatisfactory, as the rolling of the shells sideways will cause the band to run out of its straight line, causing "snaking" over the sides of the rollers. In the majority of cases where such conveyors are used they are narrow bands running in flat-bottomed wooden troughs which prevent the shells from rolling off. Supporting rollers, one to two feet apart, are placed beneath the band which is composed of either sewn cotton duck or leather. The band speed varies between 60 and 100 feet per minute; maximum capacity 2,000 eighteen-pounder shells per hour.

A portion of a standard band conveyor, by Messrs. Rownson, Drew & Clydesdale, Ltd., for 18-pounder shells, is shown in Figure 11. The whole conveyor is mounted between two channels, the idlers are of hardwood with a ferrule at each end; they are pitched 12 inches apart. The skirt boards are supported by angle brackets, all the idlers are carried in ball bearings. A typical installation of such a band conveyor in a shell factory is given in Figure 12 showing one band conveyor between each two rows of machine tools. In the factory in question 2,000 girls are employed in the manufacture of eighteen-pounder shells as well as smaller ones. This shop is part of a well-known motor works.

An interesting and more scientific conveyor, recently introduced, is a modification of the well-known U-link or drag-link conveyor, made by Messrs. Ed. Bennis & Company, Ltd., which is illustrated in Figure 13. It will be seen that this is practically a U-link conveyor supported on rails, with running wheels for each link of the chain, which is 12-inch pitch. Each link is provided with a cradle composed of two mild steel bars with a shallow V-shaped depression or gutter in the center, the sides of which are lined with pieces of "Roko" belting. A conveyor similar to that shown is used for handling shells between 4.5 and 9.2-inch. Figure 14 is reproduced from a photograph of this device.

To facilitate the more economical elevation of shells from one level to another, an ingenious appliance has also been developed by Messrs. Ed. Bennis & Co., Ltd. The contrivance deserves special notice, for though perhaps not, at a glance, easy to understand from the drawing, Figure 15, it is in reality quite simple. This elevator, unlike the ordinary bucket elevator, can only raise or lower shells on the rising or descending strand, but without negotiating either the upper or lower terminal. The illustration shows a position of the elevator in elevation (it can, of course, be of any reasonable length between centers), handling shells between four or five floors, if need be; there can, however, only be one receiving and one delivery point for each side, i. e., one for elevating and one for lowering.

The elevator as shown in the illustration rises at the right-hand side and descends on the left. As the carriers approach the first floor from which shells are to be raised to an upper floor they are in their normal position, the upper surface of the projection being slightly inclined toward the center line of the elevator. As one of these carriers rises through the floor it lifts the first of a series of shells supported by four prongs which interlace with the three steel plates of the carrier. As soon as the shell has been lifted out of place it rolls down the slight incline and rests securely in that position until it has been elevated to the floor on which it is to be unloaded. In the meantime the next shell rolls forward to be ready for the next carrier, but the flat end of the carrier prevents it from doing so too soon. upside down but by the formation of the back part, which is now uppermost, it can also hold a shell. When

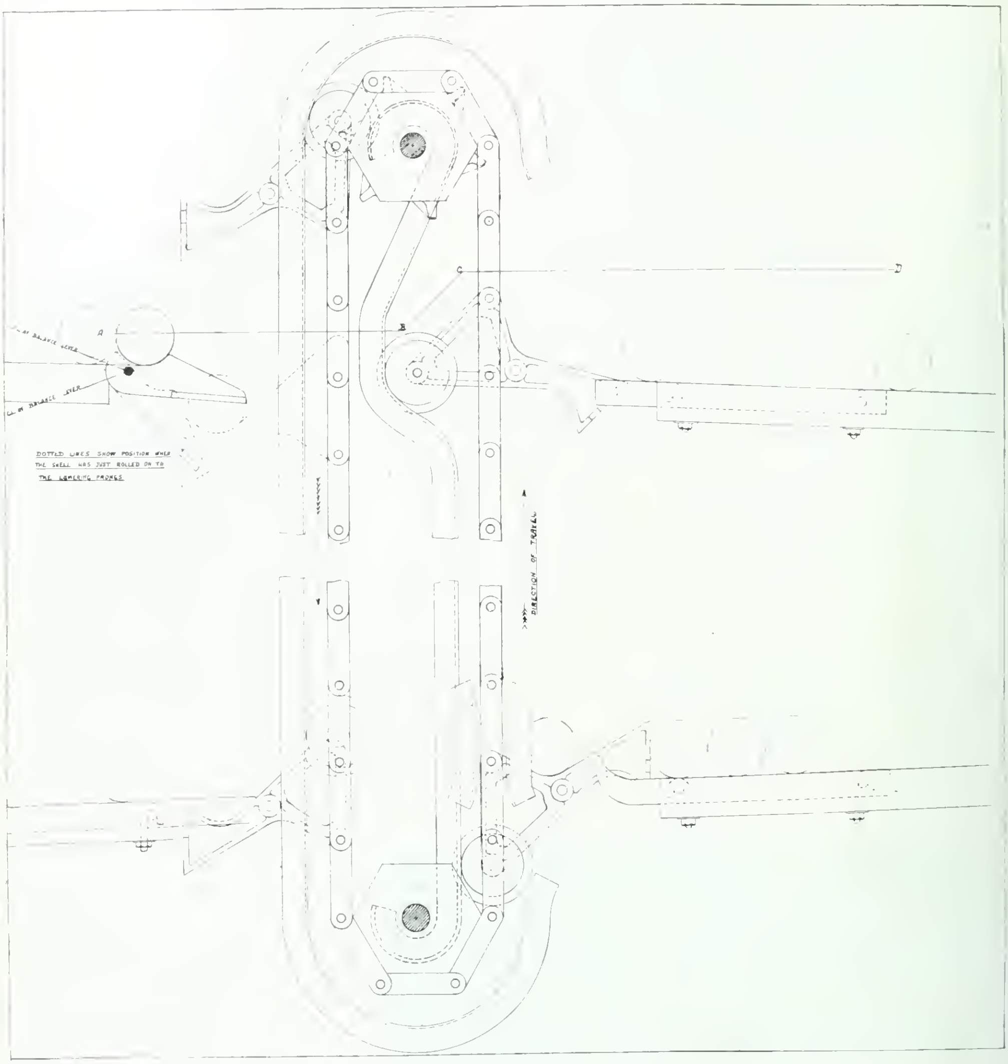

A
B
C
D
C.L. OF BALANCE LEVER
C.L. OF BALANCE LEVER
DOTTED LINES SHOW POSITION WHEN THE SHELL HAS JUST ROLLED ON TO THE LOWERING PRONGS
DIRECTION OF TRAVEL

FIG. 15. AUTOMATIC ELEVATOR FOR RAISING AND LOWERING SHELLS

When the carrier with its shell has reached the upper level, or just before, the roller on its path has diverged from the straight into a recess, it has therefore made a movement toward the center line of the elevator so that the other end which supports the shell has been lowered, see-saw fashion, sufficiently for the shell to be run off by gravity. All the approaches for the shells to and from the elevator are slightly inclined, so that they run automatically to the feeding point and off at the delivery point. It will be seen from the drawing that whereas the ends of the four prongs on which the shells are fed on are bent upward to prevent the latter from rolling off, the equivalent on the upper floor is straight for the shells to run over unimpeded.

After passing the upper terminal the carriers descend lowering, the shells are fed on in a similar way only the four prongs are here pivoted and held in position by a balance weight until the carrier negotiates the feeding point, when the prongs encounter a tripper on the carrier by which they are bent down so that one shell can roll on to the carrier. As soon as this has passed the point the balance weight will restore original conditions. The position then is shown by dotted lines on the drawing. The delivery on the lower floor is practically the same as that on the opposite side, the carriers passing through between similar prongs and simply allowing the shell to roll off by gravity.

Handling Empty Shell Cases

Before leaving this subject it might be of interest to investigate the mechanical handling of empty shell cases after their return from the front, as this offers excellent scope for mechanical devices, and this fact is fully realized and taken advantage of. It is obvious that when large consignments of shell cases are returned they must be stacked immediately, either in the cases or loose. To keep pace with the unloading operations and not to delay the railway trucks, enormous quantities will occasionally have to be handled.

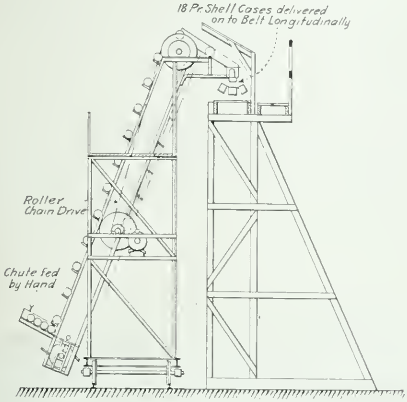
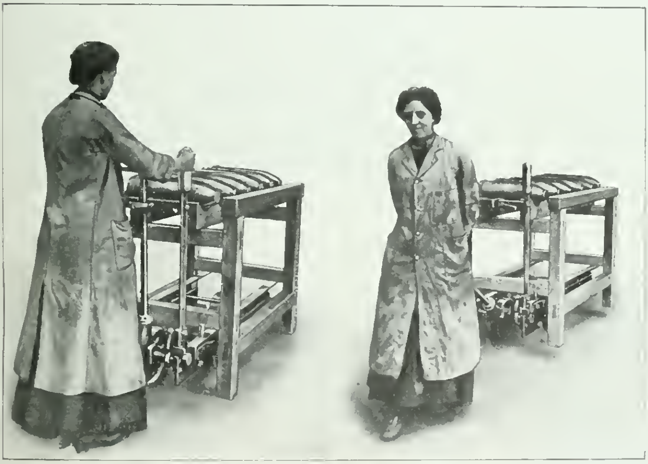
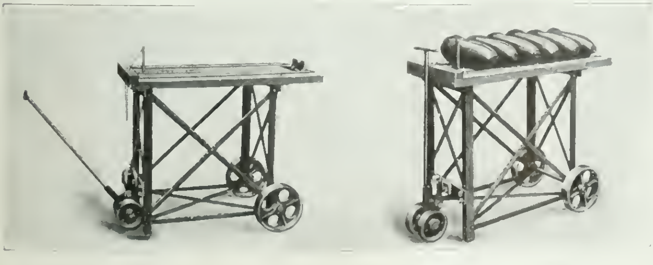


FIG. 16. PORTABLE ELEVATOR AND BAND CONVEYOR FOR HANDLING SHELL CASES



FIGS. 17 AND 18. JACK-TRUCKS FOR HANDLING SHELLS



FIGS. 19 AND 20. SHELL TRANSPORTING TRUCKS COMMONLY USED

This task is performed by gravity runways while the shell cases are in boxes. These are thousands of feet in length, in both long and short lengths; many are intercepted by short elevators which drag the cases up a slight incline for the purpose of letting them run down again by gravity for longer distances. These methods are of American origin and are too well known to require further explanation.

The method employed when handling loose shell cases is, on the other hand, of a more novel character. They are lifted vertically by special elevators and horizontally by band conveyors which are the design of Messrs. Fraser & Chalmers, Ltd., who have built the majority of appliances for this purpose. These machines generally deal with from 70 to 80 cases per minute, delivering them on to 12-inch band conveyors which are capable of handling 200 per minute and have, in fact, carried as many as 10,000 in an hour. The illustration, Figure 16, shows the general arrangement of one of these elevators, it is a portable device and is principally used for stacking shell cases; the inclined elevator is 17 feet 8 inches from center to center, and the center of the upper terminal is 18 feet above the ground level. Th level of the band conveyor into which the elevator delivers is 16 feet 6 inches above the ground level and is 12 inches wide. The cases are conveyed at that height and for long distances for the purpose of forming stacks. When feeding the elevator the shell cases are placed by girls on to the small tray at the lower terminus, one standing on each side; the cases roll down the tray to the elevator, each carrier of which takes one at a time.

Being portable these elevators can be moved along their track to any part of the yard where used shell cases have to be unloaded. Some of the conveyors which have been built for this purpose, carry the shell cases for distances of 500 feet from the unpacking sheds to the re-forming sheds, and each such conveyor saves the services of between 40 and 50 girls.

"Jack-trucks" are frequently in use in British munition works. These are so well known in the United States that it is superfluous to describe them. There is, however, one development of them, a portable stand built by J. T. Hardaker, Ltd., of Bradford, which is largely used in conjunction with overload devices. These stands or platforms are of timber and are used in precisely the same way as the usual "skids." The illustrations, Figure 17 and 18 will be sufficient explanation. The same engineers also build special shell transporting trucks illustrated in Figures 19 and 20. The pulling handle is so arranged that at an angle of 45 degrees no weight of the load is on the operator, and when the handle is upright the front legs are in contact with the floor fixing the truck firmly in any desired position; these trucks are well made and fitted with ball-bearing runners. The platforms are 48 x 22 inches in size, and the height from the floor is 36 inches. The accumulator trucks which are also used in great variety are of the "Buda" type, built by The Electromobile (Leeds) Ltd. Company, of Leeds, but as they are of American origin the mere recording of their use will suffice for the purposes of an article of this length.

In addition to the numerous methods of floor traffic for handling shells, we must also mention the two-wheeled "Sherriff" shell carrier, made for several sizes of steel billets, forgings and shells. Figure 21 and 22 illustrate this carrier empty, and when handling a 12-inch howitzer shell.

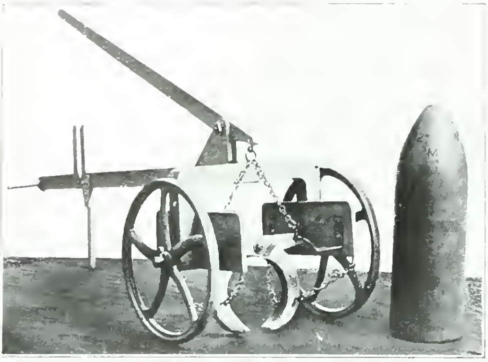


FIG. 21. SHELL CARRIER USED IN MUNITION WORKS

In some of the shell factories, during the heat treatment of shells the hollow forgings are supported during the process of cooling on four-wheeled trolleys running on rails. These trolleys are constructed of mild steel channels and girders, the main frame supporting six transverse channels, each of which is provided with four long pins or bolts, on which the shells are supported like bells, the blanks being thus prevented from touching each other and having air circulation all around.

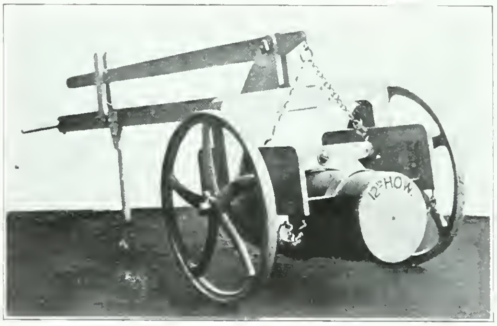


FIG. 22. CARRIER IN USE WITH 12 INCH HOWITZER SHELL

HANDLING EXPLOSIVES

So much for the handling of shells while supported from below. Explosives are always handled in this manner but as the conveyors for the purpose only differ very slightly from the methods employed in handling other bulk materials there is not much to say under this head.

Belt conveyors of a special construction are used for handling T.N.T. Figure 23 represents a cross section through such a conveyor, the width of which is 16 inches. The conveyor frame as shown is of well seasoned pine, while the trough itself is of birch. The main supports are pitched about 6 feet 6 inches apart, and every second one is fitted with an idler roller for supporting the return band. The belt is of solid woven cotton, and on the carrying side works in a slightly guttered trough instead of the usual idlers. The speed of travel is about 60 feet per minute. The operation is as follows: The T.N.T. after solidifying in the vats is broken into pieces of a size which can easily be shoveled into the trough of the conveyor in which the band moves it along; this material is delivered into a crusher at the terminal of the conveyor which has a slightly upward incline, where the larger pieces are cracked to a more uniform size and packed into barrels. This conveyor is made by the Hepburn Conveyor Co., Ltd., of Wakefield.

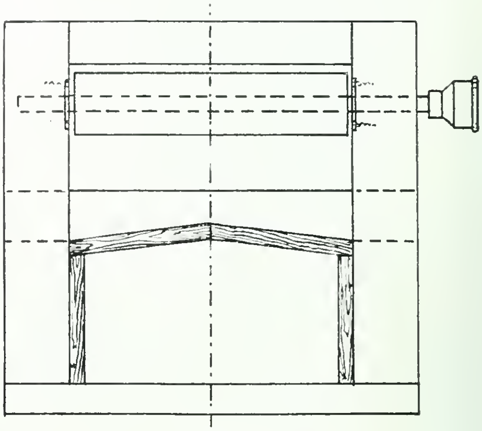


FIG. 23. BELT CONVEYOR FOR HANDLING T. N. T.

Common rubber and canvas belts running on troughing idlers of the ordinary type are also in use in explosive works, where deliquescent materials are to be handled; a 16-inch conveyor of this kind, made by the same engineers, has a capacity of 30 tons per hour.

The tipping tray conveyor of Messrs. Babcock & Wilcox, Ltd., is preferred in some of the explosive factories for handling T.N.T. and ammonium nitrate to the band conveyor.

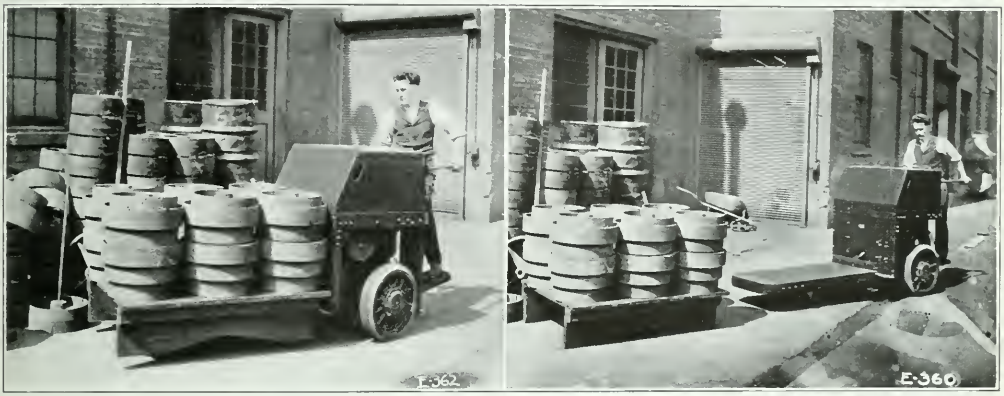
In order to help the sailors and soldiers to get back into civil life as quickly and as easily as possible, the Ministry of Labor propose to use the machinery of the Employment Exchanges, which is the only national organization sufficiently strong for the purpose, but in order to assist the Ministry and the exchanges to carry out the task which will be imposed on them, the Minister of Labor proposes to invite the employers' associations and trade unions to give him the fullest possible assistance, both centrally and locally. In the first place, a Central Committee, to be known as the Labor Resettlement Committee, has been set up, consisting of representatives of the employers and the trade unions in the principal industries in equal numbers, together with representatives of the Departments concerned with demobilization. The Minister of Labor will be Chairman of the Committee, and he has appointed Lord Burnham to be Vice-Chairman. To this Committee the Minister will look for advice and information on all general questions affecting resettlement.—*The British Ministry of Labor.*

How the Electric Truck Releases Men for Productive Work

By F. C. Myers

There are two general types of electric trucks for industrial uses. A carrier truck after lifting its load or being loaded carries it from place to place. The tractor type pulls loaded platform trucks. Seven examples show how men, ranging from a few to several hundred in plants of various industries, have been released from the work of handling material through the installation of these trucks.

Mr. Fred. C. Myers *has had an extensive experience in the use and application of electrical machinery, including one and a half years in the testing and inspection department of the Chicago & Northwestern Railroad; one year in the process inspection department of the Western Electric Company. Later he was manager of the Indiana Foundry & Machine Company, South Bend, Indiana, for ten years editor and industrial investigator for the W. R. C. Smith Publishing Company, and during the last one year and a half has been industrial investigator for the Society of Electrical Development, Inc.*



A CARRIER TRUCK IN USE, SHOWING THE EASE OF LOADING AND UNLOADING

ONE of the commonest jobs in any manufacturing plant is that of the trucker. The commonest of common labor seemed fitted for this work. The principal requirement is brawn and plenty of it. The men with the biggest biceps are given the trucking jobs. No attention is paid to what the men have from the neck up.

So the movement of material about plants and from one department to another is delayed and the work of skilled workmen hampered with a lessening of production. Desperate measures have been resorted to by some manufacturers. The number of truckers has been increased in some instances so that the men are actually in one others way. The results of such practice is to cut down productivity still more.

There is a way out of the difficulty. Use mechanical means for moving goods. One of the most versatile machines for this purpose is the small electric industrial truck. It can be used in the aisles of most plants. It takes little room and can be operated in close quarters. The design is such that the operator need not have more than mediocre intelligence.

Principle of Design

The principle of design is the same as in the larger out-of-door trucks. They have electric motors supplied with current from storage batteries. The driving mechanism is so arranged that if the driver steps from his place or leaves his seat the brakes are automatically applied and the machine stops. The speed is controlled so that the machine cannot be driven beyond a certain predetermined rate. Steering is done by one hand while the other hand is on the driving lever. If the driver moves his hand from the driving lever it immediately returns to neutral and the brakes are applied.

The current cannot be turned on fast enough to damage either the batteries or the motor. All lubrication is accessible and the batteries can be charged without removing them from the machine. If the machine is to be operated continuously the batteries can be removed and charged batteries placed in the battery box and connected up in less than five minutes. The time depends largely on the apparatus available for handling the batteries or the amount of help at hand. Usually two men with a small crane can disconnect a discharged battery, remove it, put a charged battery in place and connect it up in about four minutes.

Where trucks are to be used continuously extra batteries must be provided so that while one is working another can be on charge. One large company has found that where a fleet of trucks is in service continuously 1.4 times the number of trucks will give the number of batteries to maintain constant operation. It is common practice to charge during the noon hour or at every other period when the trucks will not be in service for from half an hour to an hour. This boosting of the battery charge is effective in reducing the number of batteries required. Where single trucks are used this short charge given during the noon hour will help boost the truck through a hard day and may prevent a slowing up of the delivery work late in the afternoon when every working minute is valuable.

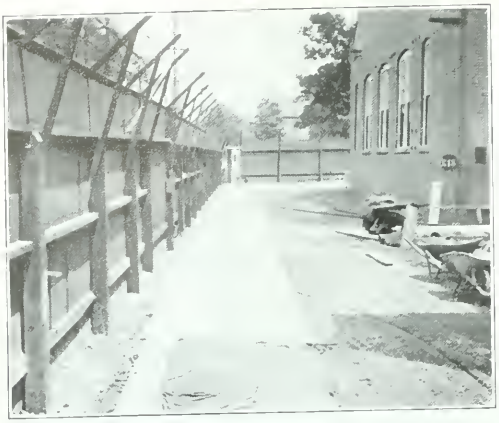


FIG. 1. CONCRETE YARD ROADWAY FOR ELECTRIC TRUCKS

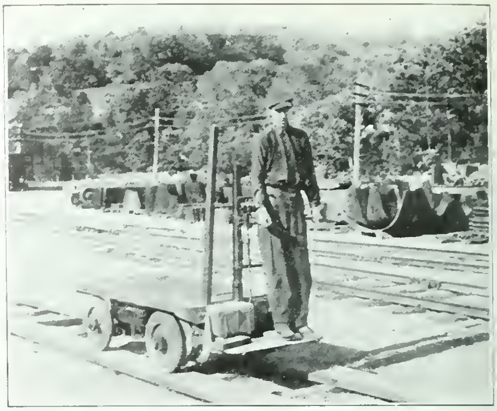


FIG. 2. WOODEN RUNWAY FOR ELECTRIC TRUCKS

Two General Types of Trucks

There are two general types of electric trucks adapted to industrial work. Each has its field and each will be found economical under certain conditions. The carrier trucks carry their load. Tractor trucks carry no load but pull their load behind them as does a locomotive. Neither type of truck depends on tracks or special roadway, although the kind and condition of floors and platforms will have an important bearing on the size of the load that a truck will handle. Grades up to 15 degrees can be negotiated without trouble, but the steepness of the grades to be encountered will materialy cut down the number of pounds that can be carried or hauled at a time.

It will be well for manufacturers intending to use trucks to look to the condition of their floors and platforms. Even the yards will bear consideration, because these trucks can operate out-of-doors as well as in. One large user of these trucks has found it a paying investment to lay concrete roadways, see Figure 1. Another has a portable track, Figure 2, which can be moved without much trouble as routes change. Long ramps are installed to ease the grades, thus making the load of the trucks more nearly equal the capacity on levels.

Carrier Trucks

Carrier trucks, two types of which are shown in Figures 3 and 4, carry the load. Figure 5 is a common style with the ordinary platform top. The platform may be changed to meet any special conditions. A comparatively new development is the lifting platform type of carrier truck. It was designed to meet the demand for a truck which could be used where the loads could be piled on platforms and the platform and the load transported from place to place. Its purpose is to replace the manually operated lifting truck which has become so common in large manufacturing concerns. The loads that can be handled by these machines range up to 4,000 pounds each. All the work of lifting and carrying is done by power, the operator simply standing in his position and operating the proper levers as shown in the illustration on page 277.

Tractor Trucks

Tractor trucks do not carry anything but the battery and the driver. They haul their load, see Figure 7. Instances have been noted by the writer where 16 trailers loaded with castings have been drawn successfully by one of these tractors. Usually two men operate a tractor and its train; one does the driving and the other attends to the coupling and uncoupling of the load. In this way large amounts of material can be handled at a very low cost.

It is especially interesting to note that several ingenious couplings have been developed so that the trains track the tractor. Square corners can be turned, Figure 8, and winding aisles can be negotiated without the cars behind cutting the corners and thus doing damage to themselves, their load or surrounding material or doors. One or two automatic coupling and uncoupling devices have recently been brought out, but usually this work is done by hand.

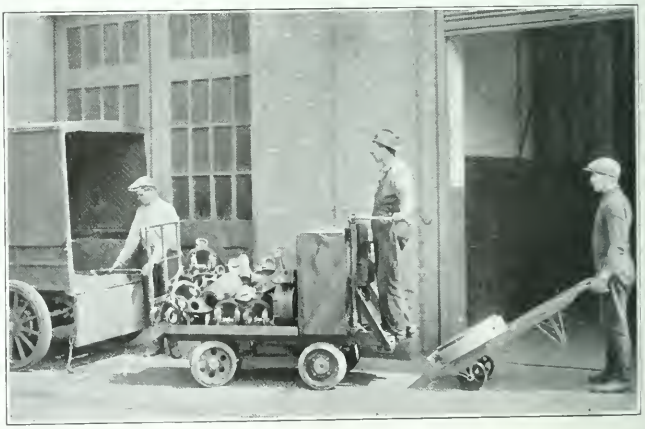


FIG. 3. A CARRIER ELECTRIC TRUCK

What has been done by these trucks in the way of producing savings in labor and time can best be shown by citing some actual instances. The names of the firms cannot be given, but the results are taken from actual observation. Several makes of trucks are included in these results.

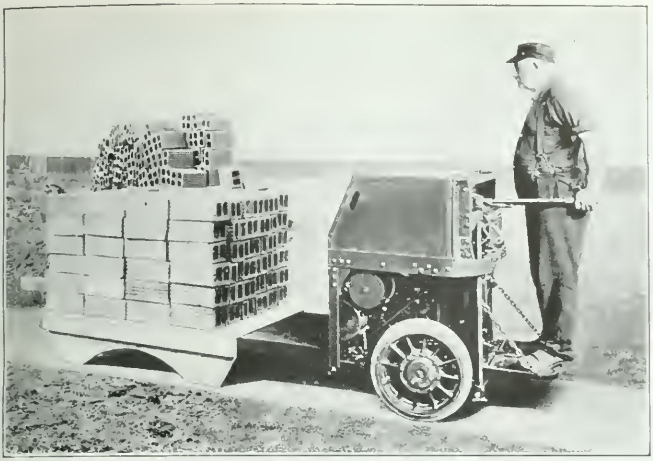


FIG. 4. ANOTHER TYPE OF CARRIER TRUCK

Examples of Savings

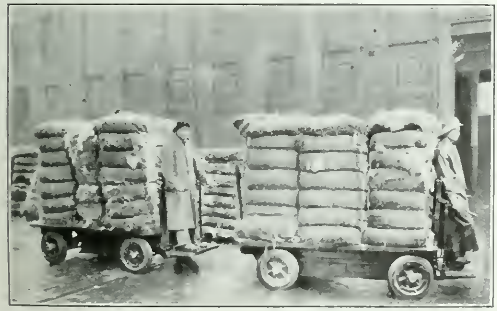


FIG. 5. TWO MORE CARRIER TRUCKS

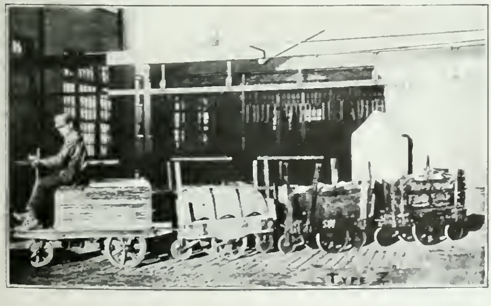


FIG. 7. MERCURY "Z" TRUCK HAULING TRACTORS LOADED WITH STEEL

An agricultural implement manufacturer, who is doing Government work, installed electric trucks with the following results: Six tractor trucks are being used to move raw materials and parts from one department to another. Formerly the work was being done by 30 men, with all kinds of hand trucks, from the 2-wheeled truck to the familiar Renolds truck. The new tractors are drawing an average load ranging from 4000 to 8000 pounds over floors of brick, wood blocks and steel plates. Some of the grades are as steep as 17 degrees and range from 25 to 100 feet in length. The speed is approximately four miles per hour.

In an automobile factory the trucking gang was reduced by 64 men by the installation of eight electric industrial trucks of various types varying with the kind of work to be done. The average load in this case is small, about 1000 pounds, and the floor areas good. Not only is there now no congestion at any point but the finished parts are handled with less breakage and damage than under the old method.

A manufacturer of electrical devices has cut 15 men from his trucking gang. In this case a carrier truck and a tractor are being used. Some of the work is on good floors and some over rough roadways. The speed is 4½ miles an hour and the loads vary between 1500 and 2000 pounds. The average length of haul is 1500 feet and the steepest grade is about 18 degrees.

A rubber manufacturer has found that two trucks, a carrier and a tractor, have materially reduced his trucking bills. In this plant the saving is difficult to state because of the seasonableness of the work. The trucks are being used for transporting raw materials and finished products. Special attention has been paid to removing finished work from the machines using both trucks, either as carriers or tractors, as the case seemed to demand.

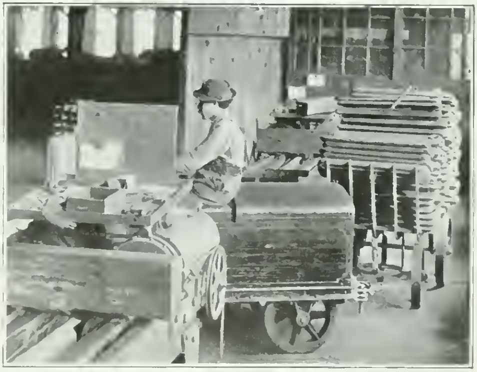


FIG. 8. TRACTOR TRUCKS WITH COUPLINGS FOR TRAILERS TO ALLOW EASY TURNING OF CORNERS

In another rubber works 16 trucks freed 160 men for other work. This tire company uses the trucks for every kind of hauling in the plant and from department to department. The loads run as high as 3200 pounds and the length of haul varies from 600 to 1200 feet. High speed is the rule, the trucks running from 8 to 12 miles per hour. There are no grades and the floors are wood and concrete.

A manufacturer of electric wire and cable says that his seven industrial trucks are doing work for which men could not be obtained. His entire method of manufacture has been adapted to the use of these trucks. There are practically no grades and the loads range from 1000 pounds to 4000 pounds over wood and concrete floors. These trucks travel from 2 to 5 miles per hour according to the work being done.

An ammunition factory is using 25 electric industrial trucks for moving material, which under the old methods would require 500 men. The hauls are exceptionally long in this case, averaging 2640 feet and the loads are heavy, about 3500 pounds. These long hauls are especially well adapted to electric truck work as it is under such conditions that the saving will be largest. In this case part of the route of the trucks is over gravel roadway out of doors.

Factors in Application and Operation

These seven examples, taken from a varied list of manufacturing plants, demonstrate what savings have been effected and the general conditions under which this type of material handling equipment is being used advantageously. The results have been gathered from the files of the users without regard to the make of truck in service. For short hauls where the routes are irregular and where the loads can be handled by the driver the carrier truck is perhaps the more common. For hauls following regular routes and where there is sufficient work to keep trucks going all the time with loading and unloading gangs, the tractor seems to be the best adapted, reducing the cost of transporting material. There is no hard and fast rule that can be laid down. Each case must stand on its own merits.

The cost of operation depends on so many conditions that those obtained in one plant would not hold in a similar one across the way. An average of a large number of installations, however, places the cost of daily operation for a 10-hour day at close to $1.20, adding in interest, depreciation and upkeep. It may run higher, or it may be materially lower.

Much of the operation cost depends on the work being done and the time the truck is actually at work, that is, moving material. All time lost waiting for a load or waiting to be unloaded is lost time during which interest and depreciation are mounting up and these are two of the heavy charges.

Superintendence of Women

By Mrs. Harry E. Huestis

Superintendent of Women, Ross Rifle Company

WE are at war. Our men are sacrificing their lives for the World's liberty "over there" in No Man's Land, and we men and women at home must give of our best—we, the soldiers in the shops.

Factory management must meet war conditions. Women are in the fight to supplement, not supplant men. If it takes four industrial men or women at home to keep one brave soldier supplied at the front, then we must have four industrial soldiers, that one brave soldier in uniform may be made sure of.

We soldier women do not want to be coddled; we want but clean sanitary surroundings for health's sake; good lighting and a contrivance of sorts to husband our strength, to help us keep in the game. We recognize that not being built as powerfully, nor generally as tall, nor with the arm reach of men, factory managers must equalize the standard height and reach of machines to our build. It is so simple a matter. Just provide suitable stools, lengthen the machine handles, etc., and establish at intervals a ten-minute rest period to ease up our unaccustomed muscles.

A hospital and a canteen are, of course, recognized as part of the equipment of all up-to-date plants.

The accompanying chart shows the women's organization in the Ross Rifle Company's plant, Quebec, P. Q., Canada.

The woman assistant to the foreman, or supervisor, is in charge of the office, engages the women employees —knowing the technical requirements of the jobs to be filled—suggests transfers and work adaptable to individual physical conditions, regulates differences between sub-foremen (or others), and relieves the foreman of all detail work, thus permitting him to give his full attention to production. The matron, who is in charge of department cloak and wash rooms, is under the supervision of this woman assistant.

Superintendent of Women

The superintendent of women reports directly to the general manager, and holds an executive position on the staff of the factory management. Her duties are many and responsible.

(Applicants for this position must be carefully considered. Women can, to some extent, learn to instruct and learn to manage, but, fundamentally, such capacity must be born in them.)

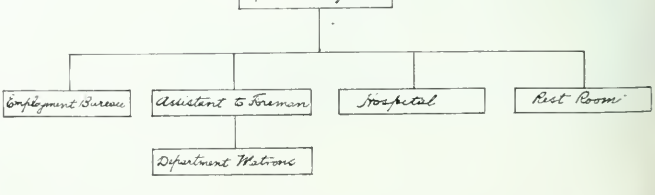
The duties of the superintendent of women are: To supervise the women's employment bureau, women's hospital, women's rest room, and women's canteen. She is also responsible for the sanitary conditions where women are working.

The superintendent of women discusses daily with the assistant to the foreman, operators' production, health and conduct, department conditions and reasons for transfers, and in this way is of invaluable assistance to the management in controlling the labor turnover.

Standard of Training for Superintendent of Women

Women aspiring to factory executive control must begin as a machine operator, and go through the ordinary routine common to all operators in the plant. The psychology of this training is important in disciplining women to accustom them to the discipline and routine of factory life, which, in turn, they impress upon others. In this training in factory routine and discipline lies ability for tactful handling of employees, and success in executive control.

Remember we go into the factory because it is war, and the extraordinary force that carries us on—we who have never known factory life before as machine operators—carries us with an indomitable will to learn and put into practice in months, what in peace time would be unheard of in man or woman except after years of training under experienced superintendents.



Depreciation and Its Relation to Industrial Appraisement

By Charles W. McKay

Every industrial executive should know the fair value of the property under his control and be able to substantiate that valuation. To obtain this figure there must be known the present or the depreciated value of the properties. In this article the causes of depreciation are given and its method of computation shown by a few examples.

Mr. Charles W. McKay *has been engaged in telephone engineering and appraisal work since graduating from Cornell University in 1906. He has been associated with the New York Telephone Company. At present he is affiliated with the engineering firm of McMeen & Miller, devoting the major part of his time to problems of appraisal of various properties.*

THE determination of the fair value of an industrial property must be predicated upon the consideration of other factors besides the reproduction cost, even though the reproduction cost is so constituted as to provide for the inclusion of the intangible as well as the tangible assets. Every industrial valuation must include a determination of the present or depreciated value of the property. If a buyer is contemplating the purchase of an industrial plant he naturally wishes to know the reproduction cost, for the reproduction cost gives him an idea of how much it would cost him to build a similar plant, and in this way affords some measure of the value of the plant under consideration. However, if he is a wise investor, he will be equally interested in the present or depreciated value of the plant whose purchase he is contemplating.

Every industrial manager realizes that his property is constantly undergoing a lessening in value, though often, he may be at a loss to know just how to determine the accrued depreciation at any given date. The engineering appraisal forms an excellent basis, not only for determining the exact condition of the property at any specific time but, also, for evolving a method of making good the monetary loss caused by depreciation.

There are four causes for the depreciation of industrial property:

1. **Property depreciates as a result of its normal use.**
2. **Property depreciates as a result of age and physical decay.**
3. **Property depreciates due to the fact that certain of its component elements become inadequate to serve the purpose for which they were originally installed.**
4. **Property depreciates because certain of its parts, such as equipment, become obsolete.**

Before considering these two functions of the appraisal in industrial management it may be well to review briefly the discussion of depreciation given in the article on the subject of "Industrial Valuation" published in the November issue of INDUSTRIAL MANAGEMENT.

FOUR CAUSES OF INDUSTRIAL DEPRECIATION

The four principal causes of depreciation—use, age, inadequacy, obsolescence—are constantly at work to effect a lessening in property values. Depreciation due to use may be partially offset by current repairs. There comes a time, however, in the life of every industrial machine when, no matter how well it may have been maintained, it is cheaper to discard it than to attempt to retain it as a part of the operating plant. This statement also applies to the depreciation resulting from age.

Inadequacy and obsolescence depreciation, however, may be entirely independent of use and physical decay. A machine that is almost new may have to be discarded because of an increased demand for the commodity it manufactures. In other words, it may have to be replaced by a machine of larger capacity. Likewise, a machine may have to be removed from service because of the development of newer and more economical types for accomplishing the same work. In fact, obsolescence is a most important factor in industrial depreciation.

EXTRAORDINARY DEPRECIATION

There is still another cause of industrial depreciation which may be called "extraordinary depreciation." Extraordinary depreciation is that due to unusual causes, such as fires, floods and, possibly, severe wind storms. Fortunately, however, we do not have to concern ourselves with extraordinary depreciation in the determination of the present value of an industrial property or in the determination of depreciation reserve funds, due to the fact that this phase of depreciation is usually amply provided for by insurance policies.

A SIMPLE ILLUSTRATION

Possibly the real significance of present value and its relation to industrial appraisement may be made clearer with the aid of a simple illustration. Assume that the reproduction cost of a given machine is found to be $100 and that the machine is five years old at the date of appraisal. From life tables, or from previous experience in industrial appraisement, the engineer may find that machines of the size and type of the one under consideration usually last about ten years, and that this ten-year life allows for all four depreciatory factors, i. e., use, age, inadequacy and obsolescence. He may further find that the machine will have a certain value at the end of its ten-year life, this value being that residing in the metals of which it is composed. In other words, most industrial machinery may be broken up and sold to the junk dealer after it is retired from service. If this junk value is assumed to be $10, the wearing value—that portion of the total value which will actually pass out of existence during the ten-year life of the machine—will be $100 less $10 or $90. We may assume that this depreciatory process will take place at a uniform rate. If such be the case the machine in question will depreciate at the rate of one-tenth of $90 or $9 a year. The accrued depreciation at the date of the appraisal will, therefore, be $9 × 5 years, or $45, and the present value will be $100 less $45 or $55.

In determining the present value of the machinery and equipment of a large industrial company, it is suggested that the foregoing method be adopted in appraising the more important elements of plant. However, results thus obtained should not be taken as final. They should be supplemented by a careful inspection of each machine, making due allowance for its actual condition as found at the appraisal date. For instance, if the machine cited in the foregoing illustration was assumed to have a theoretical present value of $55, and it was subsequently found upon inspecting the machine that it was in excellent physical condition and probably would have a remaining life of considerably more than five years, the present value should be raised, the amount of increase being dependent upon the best judgment of the appraisal engineer. On the other hand if the machine was found to be in very poor condition, the theoretical present value of $55 should be correspondingly depreciated.

In the space allotted to this article it is impossible to prescribe detailed methods for determining the present value of all of the machinery and equipment to be found in even the smallest and simplest form of industrial plant. Suffice it to say that the method outlined above will afford an excellent basis for determining the present value of the more costly elements of plant. Large groups of equipment composed of items of relatively small individual value may be appraised by more approximate methods. For instance, in determining the present value of the tool-room equipment: It would obviously be a costly and useless operation to go through the steps suggested in the foregoing illustration in determining the present value of every individual item. The appraiser, however, from his previous experience in similar problems, will be able to form a general idea of the condition of the tools by making a rapid survey of the tool-room; and, furthermore, he will be able to assign a present value for the tool-room equipment as a whole, which will be reasonably accurate.

Depreciation of Collateral Costs

Collateral costs should be depreciated at the same rate as the direct construction costs, for the reason that they are really part and parcel of the cost of the physical property. When the total reproduction cost and the total present value of the inventoriable property have been obtained, the latter divided by the former will give a ratio which may be applied to the collateral costs to obtain their depreciated value.

Many of the items of intangible value are not depreciable. For instance, good-will, cost of establishing business and cost of financing—assuming that the company whose property is under appraisement is successful—usually have a tendency to appreciate rather than to depreciate. Certain other of the intangible items are depreciable, however. Patent rights and limited-term contracts decrease in value as they grow older. Take, for instance, the case of a manufacturing company owning exclusive patents with a life of approximately 17 years. At the end of the 17-year period, in all probability, these patents will become common property and the company's competitors can make use of the ideas underlying the patents in manufacturing a similar commodity.

Obviously then, if a reproduction cost is assigned to patent-rights this reproduction cost should be depreciated at such a rate that it will have a zero value at the time the patents expire. Again, if a company is fortunate enough to possess a contract for raw material or fuel over a period of, say, ten years, the value of this contract on a reproduction basis should be depreciated annually so that it will be entirely written off the books at the expiration of the contract. Take, for instance, the case of a company that has a contract for coal at $2 a ton for a period of five years. It may happen that during the life of the contract the price of coal has appreciably increased, so that at the end of the five-year period, it may be reasonable to assume that the coal company will want a new contract at a much higher rate. If such a contract has been appraised on a reproduction cost basis, one-fifth of its total value, as thus determined, should be written off the books each year, so that at the expiration of the five-year period the contract value will have entirely disappeared.

Function of Appraisal In Determining Depreciation Reserves

There is still another way in which depreciation has a real bearing upon the problem of industrial manageagement, and here again the appraisal plays a most important part. Obviously some method must be provided for making good the ravages of depreciation. The constant lessening in value which is taking place, due to the use and increasing age of machinery and to the fact that it often becomes inadequate or obsolescent long before the expiration of its physical usefulness, must be offset in some way. Otherwise industrial companies would be confronted with one of two equally disagreeable problems. Either they would have to borrow money to replace equipment which has lived its useful life, or they would be obliged to subject the net earnings to a serious drain over an appreciable period of time to accomplish the same end.

Most of the public utility corporations adopt the practice of setting aside annually from their earnings an amount adequate to offset the cumulative effect of depreciation. Many industrial organizations follow the same practice, but unfortunotely some manufacturing companies are inclined to be somewhat lax in the matter of establishing adequate depreciation reserve funds, usually to their ultimate sorrow.

The problem of determining the annual amount which should be set aside to provide for depreciation is not nearly so complicated as it may at first appear. It is only necessary to determine a fair reproduction cost, a reasonable average life and a fair salvage value for the various major subdivisions of the plant, and with these data build up either a composite depreciation rate, or an amount in dollars which may be set aside annually.

An Illustrative Table

In solving a problem of this nature it is first necessary to have a careful valuation made of the property. Next, proper salvage values must be assigned to, and average lives determined for the various major subdivisions of the plant. With these data at hand the solution of the problem is comparatively simple. The table on page 283 illustrates the method of computing the annual depreciation reserve for a small industrial property, expressed both in dollars per annum and in percentage of reproduction cost. In the first column the various items of the plant are listed. In the second column is shown the corresponding reproduction cost as determined by appraisement. In the third, fourth and fifth columns are shown, respectively the salvage values, the wearing values and the lives in years. The salvage values are expressed in per cent. of reproduction cost, and to obtain the wearing value of any item of equipment it is only necessary to multiply the reproduction cost by the corresponding per cent. of salvage value and to deduct the product from the reproduction cost. The determination of the life in years should be predicated upon a careful analysis of all available material which will throw any light upon the average life of industrial equipment. The depreciation per annum in per cent. of wearing value, as shown in column 6 is, of course, the reciprocal of the life in years expressed in per cent. The depreciation in dollars per annum, as shown in column 7, is obtained by multiplying the various wearing values, as given in column 4, by the corresponding percentages as given in column 6.

Item	Reproduction Cost	Salvage Value %	Wearing Value	Life Years	Depreciation per Year in % of Wearing Value	Depreciation in Dollars per Year	Composite Rate in % of Reproduction Cost
Buildings	$35,000	30	24,500	25	4.00	980	
Underground structures	3,000	0	3,000	30	3.33	100	
Large machinery	80,000	15	68,000	20	5.00	3,400	
Electrical machinery	20,000	25	15,000	15	6.67	1,000	
Small tools	15,000	0	15,000	5	20.00	3,000	
Shafting	1,000	10	900	10	10.00	90	
Belting	2,000	0	2,000	3	33.33	667	
Jigs, fixtures, etc.	20,000	10	18,000	10	10.00	1,800	
Total	$176,000					11,037	6.3
Incidentals, purchasing and tool expense	14,000					882	6.3
Collateral construction costs	35,000					2,205	6.3
Land and supplies (non-depreciable)	20,000					(None)	
Grand total	$245,000					14,124	5.8

Table. 1—Determination of Depreciation Reserve.

NOTE:—This table is merely for the purpose of illustrating the *method* used in computing annual reserves. The lives are longer and the salvage values higher than would be warranted in many industrial plants. Often the composite rate will run as high as 10 or 15 per cent—in some plants even higher.

The last column of the table, it will be noted, gives the composite depreciation in per cent. of reproduction cost. The first figure in this column is determined by dividing the total of column 7 by the total in column 2. The composite rate thus obtained may be applied to the totals of the items "Incidentals," "Purchasing" and "Tool Expense" and to the total of the "Collateral Construction Costs" to obtain their respective depreciated values, in dollars per annum.

Totaling the items so far derived in column 7, we have the amount, in dollars, which should be set aside to offset the depreciation incurred in the plant under consideration during the year immediately preceding the date of the appraisal. In this case this amount is $14,124.

For obvious reasons, it may be desirable to derive a percentage which may be applied directly to the total reproduction cost of a property to determine the annual amount which should be set aside in depreciation reserve. For instance, if a certain company had gone through the rather complicated process outlined in the foregoing paragraphs, in computing its reserve fund for one year, this company may wish to eliminate the necessity of going through the same process the next year especially if its property had shown only a slight increase in value. In a case of this kind, if some allowance is made for the non-appreciable elements, it is perfectly possible to obtain a percentage, in terms of reproduction cost, which may be applied to the total reproduction cost each year to determine the amount which should be set aside in depreciation reserve, assuming, of course, that no radical changes occur in the property values.

NON-DEPRECIABLE ITEMS

Such items as land, material and supplies are non-depreciable. If then, we add these items in column 2 to the production cost of the depreciable property, we will obtain a total reproduction cost of $245,000 which, when divided into the annual depreciation, $14,124, will give the composite depreciation rate, 5.8 per cent. applicable to the property as a whole.

If this percentage method of deriving the amount which should be credited annually to depreciation reserve is employed great care should be exercised to see that the relative value of the various component elements of the plant does not change appreciably from year to year. For instance, if we use the percentage derived in the table one year, and the next year we triple the investment in buildings and attempt to determine the amount to be added to depreciation reserve by applying the same depreciation factor, obviously we will introduce a serious error. A little thought will show that any unbalance of the relative values of the items in column 2 will result in the material change of the depreciation factors, as given in column 8. It is, therefore, suggested that the detailed method previously outlined in the discussion of Table 1 be frequently employed—say every two or three years—in checking up composite depreciation rates.

IMPORTANCE OF DEPRECIATION

The importance of this subject of depreciation to the industrial manager can hardly be exaggerated. Any manager who loses sight of the fact that his equipment, no matter how well maintained, is constantly lessened in value, will some day be confronted with a very serious problem. Again, in these days when there is so much talk of Government ownership it behooves industrial managers to be well posted in the present values of their plants so that they may be in a position to submit accurate and authoritative figures at the request of the Government. There is not the slightest question but what the Government will pay fair prices for properties requisitioned for purposes of manufacturing ammunition or other war supplies. However, the Government has in its employ competent experts who are perfectly able to determine the fair present value of industrial properties, but inasmuch as these experts are acting for the buyer, rather than for the vendor, they are likely to assign lower present values than many industrial executives would feel warranted in accepting. It is obvious, however, that unsubstantiated claims for higher values will receive little or no consideration at the hands of the Government, and it is fitting that every industrial corporation should have at its disposal a complete and accurate statement, not only of the reproduction cost but also of the depreciated or present value of its property. Further, every industrial organization should be in a position to substantiate its valuation and protect its stockholders by obtaining the highest possible price for the property, always assuming that the determination of such a price is predicated upon fair methods.

Cost Estimates and Estimated Costs

By H. A. Russell

Both estimates and costs can, in general, be only approximately correct because each is influenced by certain factory averages. This statement has been especially true during the past months when material and labor have been fluctuating so widely in price. The author outlines a method of keeping approximate costs.

Mr. H. A. Russell *has been in charge of the Cost Department of A. B. Farquhar Company, Ltd., York, Pennsylvania, for the past 15 years. During that time he has directed the buying of supplies and materials, and planned and put into operation the business systems now used by the firm, the latter work being based on the study of systems and methods in other factories. He is a frequent contributor to the technical press.*

An estimator works with probabilities, but a cost accountant records actual facts as closely as the system he is governed by permits. Both must have confidence that the results indicated are approximately correct, and "approximately" often applies as much to the cost as to the estimate because a cost sheet, especially in a factory manufacturing diversified lines, will necessarily reflect the influence of certain averages.

As an example let us consider the application of the selling percentage to three articles that will often be included in the output of an agricultural implement factory—harrows, cultivators and grain drills. Any one of these implements may be better and more favorably known to the trade, or the farmer, than the remaining two and will, therefore, to a certain extent sell itself. To the total of the manufacturing cost will be added the same percentage of selling expense for all three types. If we look at the cost of the implements from the factory end we will find that one of the three is manufactured in much larger quantities than the remaining two. The volume of production helps to regulate the departmental and general overhead percentages, but the one style of implement that is manufactured in quantities large enough to influence the overhead percentages favorably, is charged in the cost sheet with the same average percentage of manufacturing expense as the two others. It will, therefore, be seen that the cost sheet will reflect the influence of certain averages, which may or may not be serious in the effect they have upon the final unit cost figure.

As another illustration of the effect of averages, let us consider the item of materials. How many of the readers of this magazine, who own or are a part of the management of a large factory which uses several thousand tons of steel bars annually, would care to state positively that the average cost of the bars in the factory racks is a certain number of cents per pound? There may be still some steel in the racks that cost 1.10 cents per pound, f. o. b. Pittsburgh, and there will be steel of the same sizes in the same racks which cost anywhere up to four cents a pound. Furthermore, the freight rate from Pittsburgh to eastern points has advanced considerably since the 1.10 price was in effect.

When we consider that there are hundreds, sometimes thousands, of items which may be looked at in the same light as the steel bars, we feel that the terms "COST" and "ESTIMATE" do not express the results we secure, but rather should we say "COST ESTIMATE" for the first and "ESTIMATED COST" for the second. Into both of these the human factor enters. If the time ever comes that we can invent a cost system that is error proof, and still come within the bounds of a reasonable expense for yearly upkeep, then we can have accurate costs and not cost estimates. By "error proof" I do not refer to mistakes in additions and extensions but to errors of judgment; and the errors of judgment may occur anywhere between the management and the cost accountant.

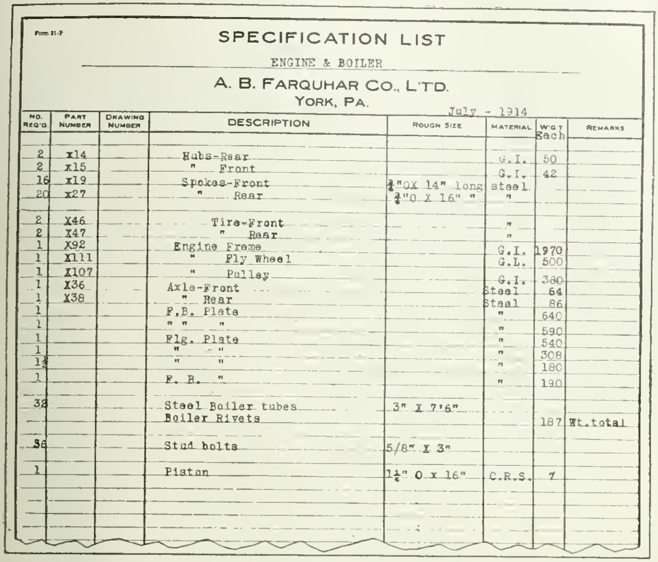
If you doubt that costs are but cost estimates, ask the owner of a large factory just how many different cost systems he has had installed at various times. If he replies that only one system has been used without even a modification, you may be sure that either the factory has not been in existence very long or that the system is antiquated. There are a number of different systems that have been carefully thought out during the past few years, and the most of them give the manufacturer a close cost estimate for the individual units of his factory output. But what we call "COSTS" will continue to include averages for some time to come.

Elements in the Selling Price

There are five elements entering into a correct selling price: The cost of the material, of the labor (productive), the share of the general manufacturing or overhead expense (including foremen's salaries, office salaries, supplies for the factory, power and artificial light, taxes, insurance, etc.). These three items should contain everything that goes to make up the factory or manufacturing cost. To their total must be added the expense of placing the goods on the market (known as selling expense and including such items as advertising in technical papers, advertising literature, salesmen's salaries, commissions, travelling expenses). The difference between the total of these four items and the selling price constitutes the fifth item or profit.

The first step in making up a cost sheet is to secure a correct list of each part that enters into the machine or implement under consideration. Not only must the quantities of each part be obtained but also the size (where size is needed and essential), the grade of the material and the kind of material; in other words, complete specifications. The next step is to copy these specifications, item by item, on the cost sheets. Figure 1 shows such a specification sheet. Figure 2 shows the material partly listed on a cost sheet. In this particular instance the cost is partly made up for one engine and boiler. None of the figures used are actual, for obvious reasons, but are entered for the purpose of indicating the method of assembling a cost in this factory. Figure 3 shows the labor cost added, also the overhead expenses and the total cost of each item, when considered as a separate unit. The weights of each kind of material are listed in their proper columns. This latter information is of considerable importance, as will be explained more fully further on in this article.

The specification sheet, Figure 1, furnishes the list of materials required. Figure 4 shows the operation time card. This card provides the information for the cost man for the actual time used in finishing a certain operation on a specified quantity of parts. Referring to the illustration the operator was paid for working on 11 pieces but only ten of the pieces were "good." Therefore one-tenth of the amount paid was the cost of each "good" piece for that operation. The eleventh piece was not spoilt by the operator, but proved to be defective after a certain amount of the machine operation was completed. The time cards used for day work or piece work are of the same form, but the day-work card is white while the piece-work card is green. The two colors simplify sorting when the cards are received daily at the main office. Not only are these cards used to figure the costs but they also furnish the time clerk with the information to make up the weekly payroll.



Form 31-P

SPECIFICATION LIST

ENGINE & BOILER

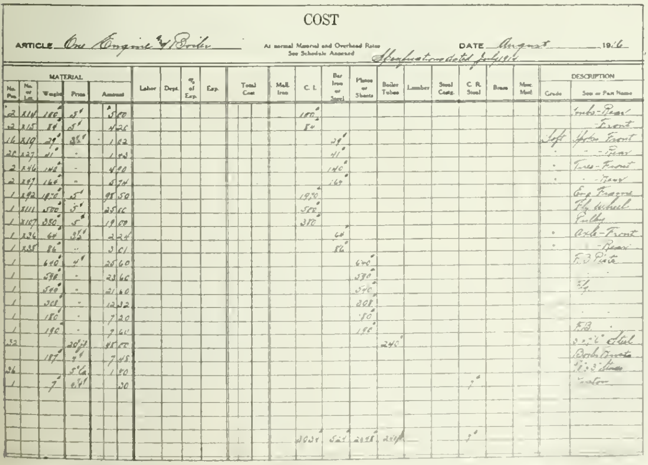
A. B. FARQUHAR CO., L'TD.

YORK, PA.

July - 1914

No. Req'd	Part Number	Drawing Number	Description	Rough Size	Material	W'g't Each	Remarks
2	x14		Hubs-Rear		G.I.	50	
2	x15		" Front		G.I.	42	
16	x19		Spokes-Front	¾"OX 14" long	steel		
20	x27		" Rear	¾"0 X 16" "	"		
2	X46		Tire-Front		"		
2	X47		" Rear		"		
1	X92		Engine Frame		G.I.	1970	
1	X111		" Fly Wheel		G.L.	500	
1	X107		" Pulley		G.I.	380	
1	X36		Axle-Front		Steel	64	
1	X38		" Rear		Steel	86	
1			F.B. Plate		"	640	
1			" " "		"	590	
1			Flg. Plate		"	540	
1			" - "		"	308	
1½			" "		"	180	
1			F. B. "		"	190	
32			Steel Boiler tubes	3" X 7'6"			
			Boiler Rivets			187	Wt. total
36			Stud bolts	5/8" X 3"			
1			Piston	1½" 0 x 16"	C.R.S.	7	

FIG. I. SPECIFICATION SHEET GIVING LIST OF MATERIALS REQUIRED



COST

ARTICLE One Engine & Boiler

At normal Material and Overhead Rates See Schedule Annexed

DATE August 1916

Specification dated July 1914

MATERIAL																				DESCRIPTION	
No. Pcs.	No. or Let.	Weight	Price	Amount	Labor	Dept.	% of Exp.	Exp.	Total Cost	Mall. Iron	C. I.	Bar Iron or Steel	Plates or Sheets	Boiler Tubes	Lumber	Steel Castg.	C. R. Steel	Brass	Misc. Matl.	Grade	Size or Part Name
2	x14	100	5¢	5 00							100										Hubs-Rear
2	x15	84	5¢	4 20							84										-Front
16	x19	29	3½¢	1 02								29								Soft	Spokes Front
20	x27	41	"	1 43								41								"	" -Rear
2	x46	140	"	4 90								140								"	Tires-Front
2	x47	164	"	5 74								164								"	" -Rear
1	x92	1970	5¢	98 50							1970										Eng Frame
1	x111	500	5¢	25 00							500										Fly wheel
1	x107	380	5¢	19 00							380										Pulley
1	x36	64	3½¢	2 24								64								"	Axle-Front
1	x38	86	"	3 01								86								"	" -Rear
1		640	4¢	25 60									640								F.B Plate
1		590	"	23 60									590								" "
1		540	"	21 60									540								Flg.
1		308	"	12 32									308								
1		180	"	7 20									180								"
1		190	"	7 60									190								F.B.
32			20¢ ft.	48 00										240							3 x 7'6" Steel
		187	4¢	7 48																	Boiler Rivets
36			5¢ ea	1 80																	5/8 x 3 Studs
1		7	4¼¢	30													7				Piston
											3034	524	2448	240 ft			7				

FIG. 2. MATERIAL FOR ONE ENGINE AND BOILER ON COST SHEET

Departmental Supplies

There are two methods used here to provide means whereby each department is charged with the supplies used. When possible all supplies are placed in the stockroom and can only be removed upon presentation of a supply requisition signed by the foreman or one of his assistants. This is undoubtedly the best method as the chances of waste or misappropriation are reduced to the minimum. There are a few items, however, that do not pass through the stockroom, these are charged in full from the purchase invoice to the department in which that particular supply will be placed. One objection to the second method is that the entire amount is charged against the department at one time, instead of as used or requisitioned. Where the amount is considerable the tendency is to raise the departmental overhead for one period and decrease it for the next. Where this policy is carried out to any great extent, the solution is to increase the length of the period so that a percentage is arrived at which is less subject to violent fluctuations. As an illustration, let us take the buffing or polishing room. The abrasive and glue for the polishing wheels is not generally purchased every month. If these two items are charged from the invoices against the department, then one month will indicate a high percentage of departmental operating expense while the next month may be very low.

The departmental operating expense should be kept separate from the general factory expense because only in this way can the smaller leaks and losses be definitely located. We furnish each foreman with a quarterly report showing the operating expense for his department. Furthermore we encourage them to come to the main office and spend some time going over the reports with the man who compiles them. In Figure 3 it will be noted that each department carries it own percentage of expense. This percentage is made up by adding to the departmental expense the proper share of the general factory expense.

Comparison of Costs and Estimates

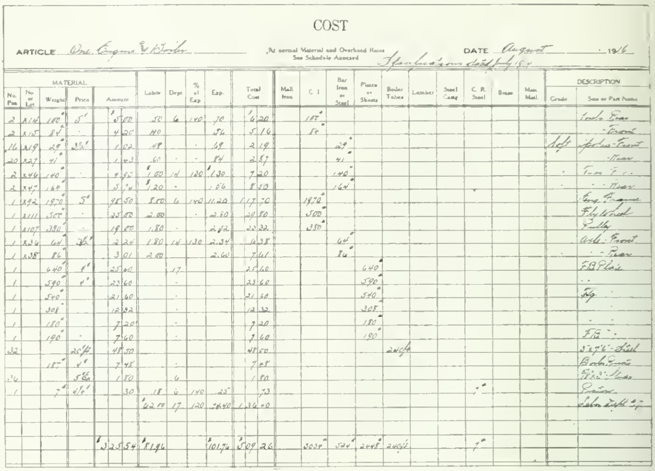
One of the hardest problems that the average cost man has to work out is the net cost of the first machine in any group. With every first machine there is always a lot of experimenting, changing of patterns, possibly the scrapping of certain parts that have proven unsuitable. Some factories have experimental departments and when the order is given to build a certain quantity, there is really no "first" machine contained in that order, the cost of the experimenting has been charged directly in the general operating expense. Many times it is necessary to know the cost basis of a single machine, even though the factory order may call for several hundred, or a thousand, similar machines and all of the machines and parts are progressing at the same time. With all the care that can be used it is seldom that this "anticipated" cost will agree with the average cost for the entire lot. Figure 5 shows the cost or estimate record card (5 x 8 inches in size). This record serves several purposes. It can be used to show the comparison between the estimated cost and the result which is known as the actual cost. It can also be used to show the variation in cost at different times.

By referring to the illustration we note that the first line in the body of the card, contains the results of an estimate made in May, 1914. These figures are in red ink. (See footnote on card.) The order for this machine was received, the quotation having been based on this estimate. The second line contains the figures (in black ink) which we consider as the actual cost. The date indicates that this cost was finished on September 14, 1914. By comparing the figures which are entered on these two lines, we find that the material was purchased at about $54 less than the estimate, but the actual labor was in the neighborhood of $23 more. There was also an increase in the total of the overhead expense, amounting to $48. It will be noted that the two gross totals compare very favorably, there being a difference of only $14. In other words, the saving in the purchase of materials just about offset the increase in the manufacturing cost over the estimate. Supposing that the material had been estimated at a figure which would have been as much under the cost as it was over, the actual cost would have been $1541 instead of $1433.

The value of a comparative record must be apparent to all who have to do with estimates and costs. Whether this form suits your requirements or not is a matter for you to decide. You may need greater detail. We have found, however, that where further analysis is required, the best results can be obtained by using the complete estimate or cost sheets.

Under the heading of the last column, we find on the first line the word "Estimate," and on the second the word "Actual." On the third line we find the word "Average." We note that the gross total of the average cost is higher than either of the totals shown on the first and second lines. As the designation "average cost" may not be clear the following explanation will be of assistance:

About a year ago we found that the prices of material and the cost of labor were changing so rapidly, that while we had hundreds of costs figured out, we were not able to keep within a reasonable degree of accuracy regarding the changes that were taking place. The cost man and his helpers were working to the limit but were losing ground each day. This can more easily be understood when I tell you that, including different sizes and combinations, we manufacture over 600 machines and implements. Of some of these the yearly output will be 20 or 30 or 40. Of others the quantity will run into the thousands. We endeavored to work out a system of short cuts, but the first stumbling block we ran into was that very few of the costs were figured on the same basis for material or labor. Bar steel ranged in base price from 1.10 to 1.90 cents per pound. There was even greater differences in many other items. The prices for material and labor had been taken at the rates which were in force when the cost was figured. This was, of course, correct but there had to be some uniform basis.



COST

ARTICLE One Engine & Boiler

At normal Material and Overhead Rates See Schedule Annexed

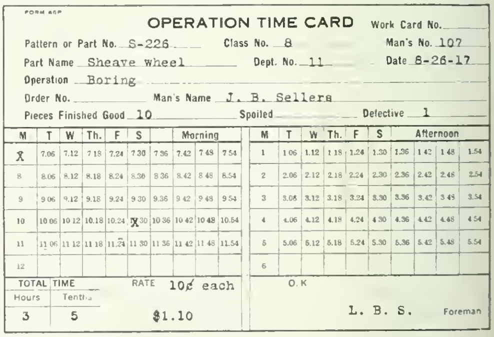
Specifications dated July 1914

DATE August 1916

MATERIAL																				DESCRIPTION	
No. Pcs	No. or Lot	Weight	Price	Amount	Labor	Dept	% of Exp	Exp.	Total Cost	Mall. Iron	C. I.	Bar Iron or Steel	Plates or Sheets	Boiler Tubes	Lumber	Steel Castg	C. R. Steel	Brass	Misc. Matl.	Grade	Size or Part Name
2	X14	100	5	5.00	.50	6	140	.70	6.20		100										Crank Gear
2	X15	84	"	4.20	.40			.56	5.16		84										- Front
16	X19	29	3½	1.02	.48		"	.69	2.19			29								Soft	Spokes - Front
20	X27	41		1.43	.60	"	"	.84	2.87			41									- Rear
2	X46	140	"	4.90	1.00	14	120	1.30	7.20			140								"	Tires F..
2	X47	164		5.74	1.20	"		1.56	8.50			164								"	" - Rear
1	X92	1970	5	98.50	8.00	6	140	11.20	117.70		1970										Eng. Frame
1	X111	500	"	25.00	2.00		"	2.80	29.80		500										Fly Wheel
1	X107	390	"	19.50	1.80	"		2.52	23.32		350										Pulley
1	X36	64	3½	2.24	1.80	14	130	2.34	6.38			64									Axle - Front
1	X38	86		3.01	2.00			2.60	7.61			86								"	" - Rear
1		640	4	25.60		17			25.60				640								F.B. Plate
1		590	4	23.60		"			23.60				590								" "
1		540		21.60		"			21.60				540								Top "
1		308		12.32		"			12.32				308								"
1		180		7.20		"			7.20				180								" "
1		190	"	7.60		"			7.60				190								Flue "
32			20 ft	48.50					48.50					240 ft							3"x7'6" - Steel
		15	4	7.48		"			7.48												Boiler [illegible]
36			5	1.80		6			1.80												[illegible]
1		7	4½	.30	.18	6	140	.25	.73								7				Grates
					62.00	17	120	74.40	136.40												Labor setting up
				325.54	81.96			101.76	509.26		3034	524	2448	240 ft			7				

FIG. 3. COST SHEET SHOWING MATERIAL AS WELL AS OVERHEAD EXPENSES AND TOTAL COST FOR EACH ITEM

After considerable consultation between the different departments interested we decided to take the average prices that had been paid for the many items purchased and revise all costs to date. To arrive at the average discount applying to square-head machine bolts, as an instance, we consulted the purchase department records for five years back. Not only was the discount taken into consideration but also the quantities of bolts purchased under each contract. Bar steel, boiler plate, boiler tubes, rivets (both large and small), belting (leather, rubber or canvas), valves, malleable and steel castings, etc., were all reduced to an average unit cost figure. This information being tabulated, it was then given to the cost man and assistance was furnished outside of the cost department. Further explanation as to how we use this average cost will be given. Where periodical costs are required, this same card will take care of 11 periods. As periodical costs are not



FORM 40P

OPERATION TIME CARD

Work Card No.

Pattern or Part No. S-226 Class No. 8 Man's No. 107

Part Name Sheave wheel Dept. No. 11 Date 8-26-17

Operation Boring

Order No. Man's Name J. B. Sellers

Pieces Finished Good 10 Spoiled Defective 1

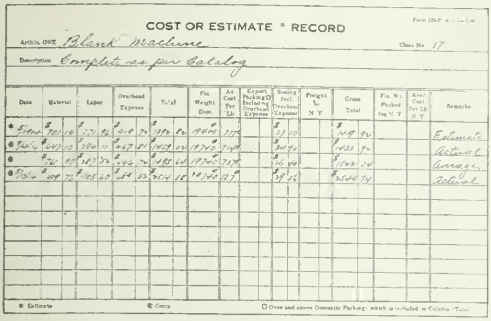
M	T	W	Th.	F	S		Morning			M	T	W	Th.	F	S	Afternoon			
X	7.06	7.12	7.18	7.24	7.30	7.36	7.42	7.48	7.54	1	1.06	1.12	1.18	1.24	1.30	1.36	1.42	1.48	1.54
8	8.06	8.12	8.18	8.24	8.30	8.36	8.42	8.48	8.54	2	2.06	2.12	2.18	2.24	2.30	2.36	2.42	2.48	2.54
9	9.06	9.12	9.18	9.24	9.30	9.36	9.42	9.48	9.54	3	3.06	3.12	3.18	3.24	3.30	3.36	3.42	3.48	3.54
10	10.06	10.12	10.18	10.24	X30	10.36	10.42	10.48	10.54	4	4.06	4.12	4.18	4.24	4.30	4.36	4.42	4.48	4.54
11	11.06	11.12	11.18	11.24	11.30	11.36	11.42	11.48	11.54	5	5.06	5.12	5.18	5.24	5.30	5.36	5.42	5.48	5.54
12										6									

TOTAL TIME		RATE 10¢ each	O.K
Hours	Tenths		
3	5	$1.10	L. B. S. Foreman

FIG. 4. OPERATION TIME CARD

usually required oftener than every six months, the card will record the costs for five years and a half.

The period is more often a year than only six months.



COST OR ESTIMATE * RECORD

Article ONE Blank machine Class No 17

Description Complete as per Catalog

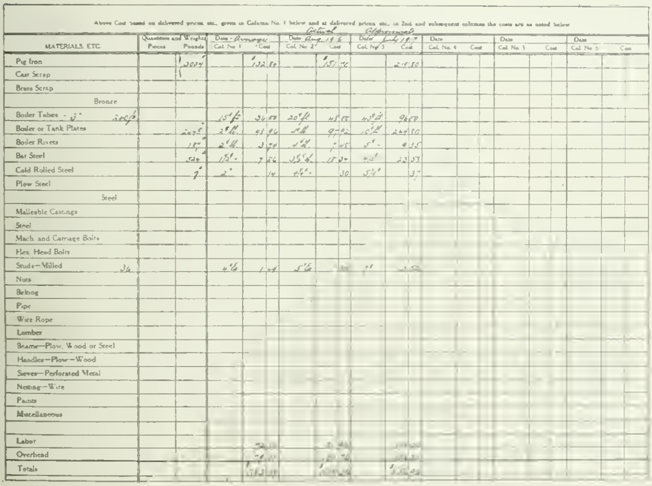
Date	Material	Labor	Overhead Expense	Total	Fin. Weight Dom.	Av. Cost Per Lb	Export Packing ☐ Including Overhead Expense	Boxing Incl. Overhead Expense	Freight to N Y	Gross Total	Fin. Wt. Packed for N Y	Aver. Cost Per Lb N Y	Remarks
* 5/1914	$701 14	$371 96	$419 72	$1392 82	1940.0	.717		$27 10		$1419 92			Estimate
● 9/14/14	$647 10	$394 11	$467 81	$1409 02	1974.0	.714		$24 90		$1433 92			Actual
●	$761 00	$387 52	$346 72	$1495 64	1970.0	.757		$26 40		$1522 04			Average
● 5/13/16	$[illegible] 76	$[illegible] 60	$[illegible] 52	$2514 88	1974.0	1.27		$29 86		$2544 74			Actual

* Estimate ● Costs ☐ Over and above Domestic Packing - which is included in Column "Total"

FIG. 5. THIS CARD SHOWS COMPARISON OF ESTIMATED AND ACTUAL COST

Short Cuts to Approximate Costs

Figure 6 shows the form used to keep approximate costs up-to-date. The top line starts out with a reference to the cost sheets which are in each instance attached. The first column contains a list of certain materials. There are a few blank lines and these can be used for items that are not contained in the list, as for instance, malleable chain, springs, etc. The second column which is headed "Quantities and Weights" contains the average cost. The third column which is headed "Date, Col. No. 1 Cost" contains the analysis of the actual cost. The next columns contains the figures representing the approximate cost at the time indicated by the date at the top of this column. These approximate costs are based on information given by the purchase department and are being constantly checked with actual costs, as the new actual costs are finished.



Above Cost based on delivered prices, etc., given in Column No. 1 below and at delivered prices, etc., in 2nd and subsequent columns the costs are as noted below

Actual Approximate

MATERIALS, ETC.	Quantities and Weights		Date - Average		Date Aug 1916		Date July 1917		Date		Date		Date	
	Pieces	Pounds	Col. No 1	Cost	Col. No 2	Cost	Col. No 3	Cost	Col. No. 4	Cost	Col. No 5	Cost	Col. No 6	Cost
Pig Iron		2034		$132 84		$151 76		219 50						
Cast Scrap														
Brass Scrap														
Bronze														
Boiler Tubes - 3" 200 ft			15¢ ft	36 00	20¢ ft	48 00	40¢ ft	96 00						
Boiler or Tank Plates		2098	2¢ lb	41 96	4¢ lb	97 42	10¢ lb	244 50						
Boiler Rivets		187	2¢ lb	3 74	4¢ lb	7 45	5¢	9 35						
Bar Steel		504	1½¢	7 56	3½¢	18 30	4½¢	23 33						
Cold Rolled Steel		7	2¢	14	4½¢	30	5¼¢	37						
Plow Steel														
Steel														
Malleable Castings														
Steel														
Mach. and Carriage Bolts														
Hex. Head Bolts														
Studs—Milled 36			4¢	1 44	5¢	[illegible]	[illegible]	[illegible]						
Nuts														
Belting														
Pipe														
Wire Rope														
Lumber														
Beams—Plow, Wood or Steel														
Handles—Plow—Wood														
Sieves—Perforated Metal														
Netting—Wire														
Paints														
Miscellaneous														
Labor				[illegible]		[illegible]		[illegible]						
Overhead				[illegible]		[illegible]		[illegible]						
Totals				[illegible]		[illegible]		[illegible]						

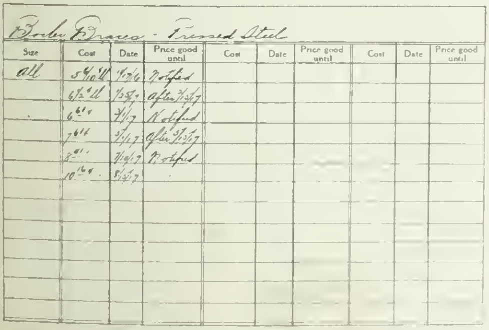
FIG. 6. READY REFERENCE FORM FOR APPROXIMATE COSTS

In considering the selling price in conjunction with the approximate cost, we do not base the advance or decrease on the difference between the result shown at the foot of column No. 1 and the subsequent columns, but between the result of the column headed "Quantities and Weights," which is the average cost column, and the column which represents the approximate cost at the time the selling price is to be fixed. This furnishes a uniformity which would be hard to secure in any other way. The basis of comparison will be the same for all the costs, providing that the comparison is made around the same date on the calendar.

Keeping the Cost Department Advised of Charges in Prices

One of the serious problems during the past year has been that of incorporating into the finished costs rates for materials which actually represented the purchase prices. The advances have been so swift and continuous, that only those purchasing departments have been able to keep in constant touch with the daily changes which have made a study, not only of the market itself, but also of the actual purchases. For the cost department to use prices which might be only a week old, would result, in many instances, in having the finished cost showing a larger percentage of profit than was actually the case.

It is equally important to keep the cost department notified of all decreases in the purchase prices. Figure 7 shows a standard 4x6-inch card, which is ruled and printed on both sides. This series of cards is run in duplicate. The original set is retained in the purchase department and the duplicate set in the cost department. Every change is noted on the proper original card first and a written notice is then sent to the cost department, where the change is noted *at once*.



Boiler Braces - Pressed Steel

Size	Cost	Date	Price good until	Cost	Date	Price good until	Cost	Date	Price good until
all	5 4/10¢ lb	7/7/16	Notified						
	6½¢ lb	7/25/17	after 7/31/17						
	6¢	7/1/17	Notified						
	7¢	3/1/17	after 3/31/17						
	8¢	7/19/17	Notified						
	10¢	8/1/17							

FIG. 7. CARD USED IN DUPLICATE FOR PURCHASE DEPARTMENT AND FOR COST DEPARTMENT

Referring to the illustration it will be noted that several of the items state that the price is good until "notified." This means that the price goes into effect on that date and can be used until another change is noted. One or two of the items specify that the change in price does not take place until a certain date has arrived. The reason for this latter method is to average the cost price where necessary. The purchase department knows about how long the supply of any one item will last and endeavors to fix the date for the new price so that the previous supply, bought at a lower or a higher price, will be practically exhausted when the latest price goes into effect.

One thing should be borne in mind when using the system of short cuts to approximate costs, and that is, that every approximate cost should be carefully checked with an actual cost as soon as possible. In this way discrepancies may be prevented in future costs.

In considering the result of the efforts of the cost department, often the only figures taken into consideration are those which represent the final total cost. Now it is very well to have some one tell you that someing you manufacure costs so much. You may justly have every confidence that the total mentioned is correct and that the cost man has been careful in gathering the data together and accurate in recording the facts. If, however, you want to know something about your costs, you must know more than the final figure. Analyze each item. Compare the total cost of material with the cost of the labor. If a cost sheet is properly prepared a comparison can be made, in most instances, between the cost of individual items and the price at which you are selling the same parts as repairs or extras. When a cost sheet indicates that there is an insufficient margin between the cost and the selling price, don't cut the quality. Analyze the manufacturing end and increase the sales. Many a high point in a cost sheet reflects nothing more than that the article is not manufactured in large enough quantities. That factory across the street may not be so modern as yours and yet be able to manufacture certain items at a lower cost than you can, simply because the larger quantity they sell demands that they use every effort to increase production.

What is the Elementary Basis of Scientific Management?

By a Manufacturer

IT may be not right to say that there was a time when man did not have a knowledge of any of the principles underlying the universe as it touches him and his activities. It may be equally far from the truth to say that man has now, in any direction, obtained all of the knowledge that there is to get.

Using mathematics as an illustration, it is hard to conceive of a time since man first formed into any kind of communities that he did not have some idea of some of the phenomena that we now handle by use of the science of mathematics. He would know that several handfuls were more than one, and so forth. After he had a lot of experimental knowledge it would of necessity be a long time before he got his knowledge in shape to apply the simple rules of arithmetic to it. It is altogether likely that many vague and erroneous views were held and put forth before even the rules of addition were known, demonstrated and accepted.

With all of our present knowledge of mathematics it may be possible that we are not at the end of all of the laws governing it, but there is a certainty that no future discovery will ever eliminate or disprove the knowledge we now have that two and two are four, or that three taken from five leaves two. It is only repeating what is known to all to say that all mathematics is founded on addition, subtraction, multiplication and division.

Knowledge of Fundamental Truth

It is true that we may have a heap of facts, and may call that heap a science when it is not. It is also true that there may be a science of a subject even though the knowledge of that science is not widely known, and many may be working from a wrong standpoint.

Every one who has to do with things mechanical knows something of inventors who spend time and money on inventions which do not follow the well-known and simple laws of mechanics and so are doomed to failure. It is also known that even with things that are in a measure a success it often happens that material is wasted because of incomplete information.

Emergency Building

If a man had to build a bridge in the wilderness, and had to do it at once, he would be justified in using any material at hand. The results might be a very poor bridge indeed and yet be vastly better than no bridge.

If a man who knew all about building bridges should have to train a number of men to go and design and build bridges, very early in his training he should teach the underlying principles. Before a man would be at all competent to pass judgment on a bridge design he would have to have such knowledge. A bridge might fail and still the design might have been right. A bridge might give service, and yet the design might have been wrong. The first step to a correct opinion must be a knowledge of the fundamental principles.

Under the general title of scientific management with its numerous sub-divisions, such as cost keeping, premium system, time study, efficiency, burden distribution, and so forth, the world has had displayed numerous designs. These designs may be said to be designs of bridges. Some of them were designed to bridge the space between the workmen and the employer.

Foundation Stones

Just so surely any other science has its foundation stones. Regardless of our knowledge of any subject, if the foundation stones are not known in an understanding way we do not have a real science of that subject.

If scientific management is really a science and not merely a name it has a real and understandable foundation. If it is a science what are its fundamentals?

The elements of all sciences are accepted by educated men. They are beyond the realm of doubt or dispute. They are immutable.

What are the elements underlying and absolutely essential to scientific management? What are the elements without which our efforts are doomed to failure? What is the one indispensable ingredient?

The Indispensable Element

Addition is the one indispensable ingredient of mathematics. Subtraction may be said to be an inverted addition, or a negative addition. Multiplication is continued addition, and division is continued subtraction. Remove addition of all kinds and what have you on which to build a science of mathematics? Is the slide rule an element or a tool of the science? Is either algebra, trigonometry, logarithms or calculus a possibility with addition eliminated?

Before it was known that the sun and planets are round bodies floating or moving in space, many complicated and elaborate systems were produced to account for the movements of the stars, planets and sun. Some of these systems contained sound reasoning by able and learned men but, lacking the correct starting point they were failures and the conclusions were wrong.

Scientific Management as a Real Science

I would say that I believe in scientific management as being capable of becoming a real science. When it does it will not need to take second rank in point of usefulness to mankind in comparison to any other of the sciences. It has one element that is *absolutely* essential.

While this element is one that is very well known and often used, I do not find that it has received any general recognition as being the one *indispensable* ingredient.

There is not a successful manager in this country who has not had some plans that he thought well of go wrong, and has wondered why; nor is there one who has not seen some plan that he did not think was as good as his own that worked better than his did.

International Standards A By-Product of the Great World War

By Herbert T. Wade

The Allied nations are standardizing war materials—a true process of international standardization. This article is an appeal to carry on this process for the days of peace and thus usher in a new mechanical and industrial era, which will be marked by an increase in efficiency and an elimination of waste, and will help make up a part of the destruction of world resources that the years of war have brought.

Mr. Herbert T. Wade *was educated at Columbia University, and for several years thereafter was an assistant in the department of physics. Since 1900 he has been editor for physics and applied science for the New International Encyclopaedia and the New International Year Books. In 1906, in collaboration with Mr. William Hallock he published "Outlines of the Evolution of Weights and Measures and the Metric System." He is a frequent contributor to technical literature, especially on matters concerned with metrology.*

WHILE it is a tendency to assume the general application of the broad policy of standardization as a basic principle underlying all present day engineering and construction, and to offer it as the explanation of much of the success that has been achieved in individual shops, in separate industries and in the engineering practice of a particular country, yet the relative importance of such fields of standardization in the mind of the average engineer or manufacturer is probably well represented by the order in which these different classes of standardization are mentioned. Practically every engineer or manufacturer of the present day, who has advanced beyond his predecessor of a half century or more ago, firmly believes that a policy of complete standardization is not merely advantageous but absolutely essential for the efficient operation of his own shop. Furthermore, he may think it a desirable thing for a special industry, yet be decidedly lukewarm when it comes to the development of national standards that may embrace a number of industries, and probably he has little, if any, interest in the general matter of international standards. To such a man, standards developed outside of his own special establishment usually signify little else than changes in designs, patterns, tools and processes, involving considerable initial outlay and promising for the immediate future but small returns. Indeed, with business active and plants working to full or over capacity, there seems to him no special incentive to develop policies of standardization, while at times of slack production and curtailed demand it is felt that any outlay or change of policy or any design involving much new equipment would not be justified.

Two Methods of Production

The adoption of a policy of standardization leads to the development of two distinct production groups in an industry, one organized on a large and comprehensive basis where an entire article or product is produced in a single plant or related factories by a complete process of manufacture, and the other where the assembling of standard parts made outside of the main works figures to an important degree. Both of these methods only can come where there is a comprehensive policy of standardization, for the raw materials and machinery used in their transformation and every intermediate process and product, require quite as much standardization in their adaptability to wholesale processes of manufacture as standardization of the various interchangeable parts.

In a large establishment of the former type, there are apt to become permanent standardized parts or materials according to the ideas and practices of the special plant, many of which may be faulty and obsolete but which persist through the universal demand for the product and the lack of competition. Various large industries could be cited where mechanical inertia has led to the retaining of special shop standards that in general practice long since have passed away in favor of universal styles and sizes. It is as essential that a corporation predominating in an industry should be brought to realize the importance of observing general standards no less than the humbler members, for no monopoly can endure permanently and should not be suffered to hinder mechanical progress.

Different Degrees of Industrial Standardization

In any industrial nation there may be many systems of standards for various articles, and their evolution may have been the result of either long usage or chance, or, in the case of those adopted latterly, of careful scientific investigation in which laboratory and research experts have coöperated with practical men. For example, in the electrical industry there has always been an intimate relation between the physicist and the electrical engineer and manufacturer, whereas in other lines the connection of the chemist, metallurgist, engineer of tests, and research bureau laboratory until comparatively recently has not been as intimate. In the smaller plants particularly, either from force of circumstances or from choice, the service of scientific men able to introduce precision of measurement and accuracy of control as well as improvements in processes into the works are not always available. Consequently, such plants failing to receive at first hand the benefits of technologic advance and scientific progress, must depend upon outside advice, coöperative laboratories, or government bureaus of standards or technology. Where the government bureau is adequately maintained, particularly where the members of the various industries coöperate in its work, it becomes a valuable adjunct in developing and maintaining standards that are much to the advantage of the industry.

Standardization is a Public Need

Manufacturers generally have failed to take into consideration that unless considerable standardization work is accomplished, either by a national government or by a general coöperation of all interested resulting in definite standards and specifications, that manufacturers and consumers generally will be at the mercy of large corporations or trusts, who can establish and enforce their own standards and specifications, developed with regard merely to their own large establishments and special methods and markets, and perhaps without due consideration of the needs and circumstances of the industrial world as a whole, particularly of allied industries. This has been recognized in the case of certain large American corporations, including several that have made a notable record in the export trade by maintaining a highly standardized product, but their standards are purely individual and aside from the finished article are not always the best.

Not one or two large corporations alone should set standards, but the government through its National Bureau of Standards. The manufacturer or engineer through the various technical societies, the commercial distributing agencies and consumers generally, all should unite in considering the needs of an industry as expressed in a policy of proper standardization. This should be done so that a manufacturer may be independent of the large corporations, and may be able to purchase his component parts or tools in the open market, and thus be on the same footing as regards the corporations who are able to develop special standards through their private laboratories. Indeed, it is hardly too much to say that the future of the individual manufacturer in any of the large industrial nations is intimately linked with a policy of standardization and the formulation of national standards.

Typical of this power and tendency might be cited the case of certain bolt-and-nut manufacturers in the United States who now list square and hexagonal nuts and bolts whose heads are smaller than those of the United States Standard. Indeed, this had become so general that in 1917 it was proposed to reconsider the standard in the interest of a harmony based on the smaller sizes.

The Aim—International Harmony

In some lines and industries, there has been fairly complete standardization, but in others much remains to be done. Efforts in this direction of new and national standards, however, should aim at international harmony which in view of the universality of scientific knowledge and methods, is in no way impossible. In view of the fact that international standards must follow national standards, it is of interest to consider the latter. In Great Britain, where the mechanical and engineering industries have progressed along lines of special design and construction, marked by refinement of workmanship and adaptability of the individual machine to the specific need for which it is intended, workmanship and finish have been developed generally to a high degree, but this policy has not proved so effective as that of the interchangeability followed in the United States. The mass production of American manufacturers has resulted in articles that have met the requirements of those who had employed special British articles at greater expense, and the interchangeability in machine tools and other products has led to prompt deliveries where speed in filling the order was an essential element.

It has been realized for some time in Great Britain that this intensive individualism for special work rather than manufacturing, was a weakness in the production system, and for many years more enlightened manufacturers have realized the necessity of a change of policy and increased standardization, a notable instance being the standardization of locomotives used in India.

Progress in Great Britain

The British Engineering Standards Committee is one of the most comprehensively and broadly organized bodies that has ever engaged in an undertaking of this kind. Practically all the various fields of engineering have been included and there are many sub-committees all made up of specialists. A number of these subcommittees in their point of view are far from provincial, and they have consulted with representatives of allied interests in the United States and in Europe with the aim, where possible, of securing standards of international application. They have considered the work of the American engineers where standard rules or specifications have been adopted, and in a number of cases have proposed conferences looking to joint or international action. In some cases the government has assumed the responsibility of arranging these international conferences so that they would assume an official character.

In many of the British sub-committees, however, there has been no desire for unification or coöperation with France, Italy, or the Scandinavian countries, so that the British policy as a whole cannot be looked upon as international, except in its ambitions to establish itself in that position by the importance and force of British overseas trade, especially in the engineering industries.

Great Britain through its one-time predominance in the world's markets naturally has established certain standards such as the Whitworth thread, Birmingham wire gauge, and others in extensive use upon the continent of Europe and in distant markets, but these standards are not exclusive and they exist side by side with other European and American standards in varying degree. In France, Belgium, Italy, and Switzerland there also has been some progress toward standardization, but the idea of special construction long persisted, due largely to the absence of establishments for mass production so familiar to us in the United States.

Trend of Continental Europe

In Germany, standardization became established as a fundamental of the German military system, and from the standardization of men to the standardization of material was a natural step that has been followed quite as assiduously. War material naturally has played an important part in German technology, and as in no other country, the interest, influence, and control of the government has been felt and a correspondingly high degree of standardization has been secured by large manufacturing industries. There standardization naturally has figured in the increased efficiency and output.

There have been attempts of engineers in Continental Europe to develop various international standards, such as the international system of screw threads which has found wide vogue, and has been generally adopted, but older systems and particularly the British Whitworth system still persist, and the same is true of other features of mechanical activity.

As an example, of standardization in the interest of economy, there may be cited the case of rolling mill sections which within a few months German manufacturers have decided to reduce in number, and to establish in standards to be generally observed. This measure was not exclusively a war measure, as it was contemplated some time before the outbreak of the war, the idea being to establish certain standardized structural shapes to the exclusion of special types which would be rolled on special order at increased compensation to be agreed upon by customer and mill.

Desire for International Standards

Now with many and various national standards and a few attempts at international standards not at all international, one could go through the range of machinery, products, and materials of the various nations of the world, and show a lack of harmony in sizes, types, qualities, and method of preparation and of packing. The confusion and obscurity, as well as the lack of properly organized effort rather than any intrinsic difficulties in the way of improvement, is responsible for this condition.

With articles and materials figuring in the world's trade and in more or less constant demand, it would seem a logical development to ask that the product of Australia or of Central America, or of Europe, or Asia should be assimilated to a single standard and so graded and packed, and, conversely, that a foreign consumer in Australia for example, should be able to order in any market of the world such commodities as he needed, relying on a certain single and defined standard of size.

Function of An International System

To realize this condition is the function of a system of international standards. Efficiency rather than tradition or local prejudice now prevails in engineering the world over. American rails were laid in the railways of France and Russia, and if rails are required for a railway in South Africa or Australia, it should be possible for mills in America as well as in Great Britain to compete for their supply. In the case of standard tires and rims for motor cars, to cite a recent case where international standards are demanded, this desire is practically universal. The record of the world's commerce shows that articles are shipped all over the world, and not merely to the nearest countries. Nevertheless, owing to the lack of harmony in designs, sizes, and patterns such trade has been very complex.

Inasmuch as the world is becoming increasingly civilized, not merely as regards its habits and apparel but its industrial organization, machinery and equipment far from efficient or standardized, that once might have served for a mining camp or pioneer or frontier work is not tolerated now. To-day efficient industrial organization is permeating to the far corners of the globe, and the idea of the bonanza is being displaced by efficiency. Every nation requires materials and commodities from other nations, but it is learning to require the best and to demand standards. In one shop engaged on fine work, the writer has seen tools from five different countries all purchased after careful consideration by the engineer in charge. These were the best in their respective lines, but how much more efficient they would be as a whole if they had all been standardized.

Standards of Materials

The problems of international trade, to-day and after the war, will not be widely dissimilar from those a quarter or half century ago in a single nation. Transportation and communication have brought the peoples of the world and their respective markets into closer communication and understanding of one another, and if all are to participate in any future relationship, they must assimilate to common standards of material as well as ethics.

Today, there is a distinct lack of international standards in the markets of the world. Certain national standards have established themselves at various points, but no one can say that their hold is supreme. In the fundamental matter of screw threads, we find today the British or Whitworth thread in conflict with the United States Standard or Franklin Institute standard, and with the International System or Metric Standard. In the matter of gages, railway equipment, structural steel, and in short throughout the range of materials and articles of construction, there is no special reason for any wide diversity and lack of harmony, except a natural and independent growth of the engineering industries manufacturing these products, for the use of them is quite similar and local conditions are ceasing to predominate. Everywhere commerce is transacted, we find different systems of weights and measures, qualities, classification, specifications, etc., for articles or materials serving the same essential purposes. That there is difficulty attending this condition is amply demonstrated by the fact that often specialists skilled in the practice of two trading countries, as well as conversant with the production and use of the special articles, are required in the various transaction.

Our Lack of Military Standards

During the few months that the United States has engaged in the great war, the country has been brought face to face with the disadvantages evoked by a lack of standards. Lack of standards in military supplies has been responsible for failures to manufacture and concentrate available munitions when they were most needed, and to utilize existing machinery in the manufacture of articles which were required by the Allied powers. Nevertheless, there has been an inevitable, if belated, tendency toward common standards established in the course of the war to secure interchangeability of munitions. More than once it has been found necessary at a comparatively late date to accept foreign standards in order to provide the necessary military equipment. With an impending war so clearly indicated it would have been at least the part of prudence for America to have developed standards, especially in view of the international coöperation to which future materials to be manufactured might have conformed.

Already, the war has established production according to standards in many lines in Great Britain, France and the United States, and this policy is likely to be developed still further. Under such conditions is it not desirable to see that such standards for articles in general use and demand should be harmonized and made universal? and that a standard article such as a motor truck or airplane should be made of standardized parts available in all countries of the world? It has been reported that at a government warehouse in Paris, separate parts for motor vehicles are maintained and cataloged in excess of a million different numbers, and naturally any repairs or replacements on trucks in the field is a far from simple process.

World Standards in Development

Now with world standards in course of development it is not unreasonable to ask that all later and peaceful applications of these various articles be considered where such action does not interfere with their military availability. If we are standardizing motor vehicles for the American Army, is it not advantageous to consider European needs and conditions and also the possibilities of European markets, if such can be considered without impairing speed of construction of their military purposes? The same conditions doubtless will hold true in European works that are turning out standard products for American troops. If the supply bureaus of the various nations can consider the question of international standards, they will be playing an important part in making the world safe for democracy, not only by the successful conclusion of the war but by the establishment of an industrial independence.

After the war, industry will be faced by conditions never before realized. Everywhere throughout the world, even today, there is need of new facilities for the prosecution of industry. What will be the condition of tomorrow? Everywhere new equipment, new construction and new materials will be called for, and manufacturers will be put to it as never before to answer these demands.

Obviously, the most efficient methods and speediest results can come only with a policy of standardization where materials will be supplied standardized and available for general use. Every country will need standardized machinery in the arts of peace just as it has needed it for war. The United States in particular is in a position of advantage for it has demonstrated its ability to develop standardized machines not only for its own industries, but in some cases those that have proved generally acceptable abroad.

America Must Appreciate Her Position

But American manufacturers must remember that with the completion of the war all industry will be resumed, and while they may be able to continue to occupy foreign markets for a time, yet soon producers nearer to the consumer will be able to satisfy his more exacting requirements. The condition of war will have passed, and though demands may be urgent, yet as a foreign army officer purchasing supplies in this country told the writer, the Europeans no longer will be satisfied with materials which they were taking now under military stress.

Many manufacturers look for the re-establishment of German industries along efficient lines, if not in Germany at least in neutral countries under German ownership or control, and it is fair to assume that even during the war, the Germans have not lost the advantages of organization and thoroughness which for many years have proved so characteristic. Germany may not be restored to her former industrial position, but Americans cannot afford to take any chance if they desire to occupy the markets of the world, and America must look to the markets of the world for, more than ever, its future will be manufacturing rather than agricultural and its products will be in excess of its local needs.

America must appreciate the matter of world standards and contribute its important share to international standardization. It can and should compete in the markets with all comers in the matter of quality and price of product, but it should not handicap itself at the very outset by undertaking to wage a battle of standards in behalf of American ideas, preferences, or prejudices, where suitable thought and action in advance, not only could remove any such necessity but could provide harmony and more efficient conditions of manufacture. The battle of the standards, if there should be any battle, for usually it is rather a policy of agreement and conciliation, should be fought in the international committee or conference by expert engineers and the best representativs of all concerned from producers to consumers, and a verdict here should be regarded as final and observed as such in succeeding legislation.

Engineer and Manufacturer Must Coöperate

In the establishment of international standards and international systems, the engineer and manufacturer early should coöperate to the end that ultimately an ideal system with complete standards for all fundamental commodities should be established and maintained, but the matter is not confined to the engineering and manufacturing industries, it is equally important for food and other commodities. and in every case the universality of definition, grading, nomenclature, and other essential features would be desirable. Such a step is not to be taken independently, suddenly, inadvisedly, and without due consideration. In every engineering profession or manufacturing industry, there are institutes or associations with committees ready to consider such schemes. Each nation maintains one or more bureaus, laboratories, or institutions whose experts and advisers can take up the matter scientifically and dispassionately and arrange for government interest and foreign coöperation just as has been the case with the International Electrotechnical Commission. It means effort on the part of a few far-seeing men to start such a movement in the great countries of the world.

The Practical Question

The practical question today is how to realize these international standards. The most obvious method is to bring the matter to the attention of every engineering, technical, manufacturing and commercial body, and especially those that maintain committees charged with the study of formulating and maintaining standards and practices for industry. The various national bureaus of standards and industrial laboratories or other scientific or commercial bureaus should coöperate. If the product of any industry or trade is not sufficiently standardized a beginning should be made, and in so doing cognizance should be taken of European practice and the advice of European experts should be solicited. In the meantime, when such standardization is going on abroad, as, for example, that being accomplished by the British Engineering Standard Committee, American authorities should submit their suggestions and arrange where possible, for formal coöperation. If such coöperation can take the form of an international congress to study the matter, and diplomatic functions be given to the technical delegates greater influence will result from their deliberations.

In many cases, these deliberations will involve further studies and practical laboratory or scientific tests. These can be carried on either in the various nations, or if desirable special laboratory research or experimental facilities can be established. Indeed, the suggestion might be made for an international mechanical tribunal somewhat along the lines of the Hague Peace Palace, where permanent machinery could be maintained for the diplomatic and administrative sides of these various international congresses, and the work of international standards committee, so that there would be no loss of time and a number of subjects could be under discussion and action simultaneously. Such an international central bureau might not have laboratory facilities of its own, but it would not aim to reproduce existing equipment such as is now maintained with high efficiency at various national bureaus and national laboratories.

Such an international bureau might be a place of depository for various standards once they were determined, and facilities for comparison and checking could be maintained. Furthermore, this bureau could accommodate the various international technical congresses and arouse their interest in problems of standardization, where such interest is needed.

With such international standards established, it is safe to say that a new mechanical and industrial era will dawn, and that by increased efficiency and the elimination of waste, both of material, time, and effort the world will be able to make up in part for the utter destruction of resources which the years of war have produced.

The spread of interest in industrial management is indicated by the fact that a lectureship in this subject is to be established at the Manchester Municipal College, Manchester, England. A sum of £3,000 ($15,000) has been anonymously subscribed to be spent at the rate of £600 a year for five years toward the cost.

The Employees' Benefit Association IV.

What Benefits Are Right? Should Beneficiaries Be Supervised?

By W. L. Chandler

The ten questions in this installment of Mr. Chandler's *series deals first with the amounts of benefits that can safely be paid for disabilities and death. Several tables give the practice and experience of the large number of benefit associations. Second, the important matter of supervision of beneficiaries is taken up.*

Mr. W. L. Chandler *has had experience in every department of the plant where he is now assistant treasurer, The Dodge Manufacturing Company. Of late years he has specialized on the study of employees' relations. He has been identified with many local and national movements, and was chairman of the Danger Emblem Committee of the National Safety Council, and is chairman of Purchasing Agents' Committee.*

HOW much money does a man need when he is sick or injured? In reality he needs more than when he is well because his expenses are heavier. In practice, however, we cannot pay all he needs or we shall find that we are putting a premium on disability. When benefits received during disability are less than the wages received when a man is well, a beneficiary is in effect participating in the loss, is a co-insurer to a certain extent.

This is as it should be, for in practically all forms of insurance it is customary for the insured to assume part of the risk. In most cases the insurance company carries 80 or 90 per cent. and the insured either 20 or 10 per cent.

PROBLEM NUMBER 48

WHAT AMOUNTS OF BENEFITS ARE FAIR FOR VARIOUS PERIODS OF TEMPORARY DISABILITY?

The amounts of wages or manner of living manifestly affect this question. A very few associations base all dues and benefits upon the wages or average earnings; others attempt to arrive at this by dividing the membership into various classes according to age, wages or some such basis.

For convenience, all benefits of the associations are converted to a daily rate assuming six days to a week and 26 days to a month. (See Table 4.) The class of members paying highest dues and receiving highest benefits are called the high class, while those receiving lowest benefits are called the low class. No figures have thus far been compiled for the intermediate classes, as the situation is rather complicated and the information of doubtful value. The figures given are intended only as a general guide.

The benefits range from 12 cents to $4 per day, the predominating rate being $1 per day for the first period.

Of 306 associations having only one period of payment, there are 66 different plans of benefits. The average is about $1.02 for the highest class of members, and 51 cents for the lowest.

Table 4 gives an approximate average of benefits paid for one disability in associations which pay specified sums, as distinguished from those paying only the receipts from per capita assessments.

Some associations provide that benefits shall not exceed some stated proportion of the wages received. These vary from one-third to full wages, but one-half and three-quarters are the popular limits.

Of the above associations, comprising about 312,000 members, the average amount paid for one year for temporary disability was $4.01 per member. Of all members, 21 per cent. received benefits during the year, the average being $19.12 per year per beneficiary. The average disability was 22.2 days per person receiving benefits and 4.7 days per member of the associations.

Expenses during disability are greater than when well, but with our present state of development it is undesirable to arrange for benefits greater than ordinary income, for this would put a premium on malingering.

TABLE 4

AVERAGE DAILY BENEFITS FOR ONE DISABILITY

Associations having	Period	Class of members	Percentage of 429 associations included	Average benefit per day
One period	1st	High	65	$1.00
		Low	17	.51
Two periods	1st	High	23	.81
		Low	7	.42
	2nd	High	23	.61
		Low	7	.31
Three periods	1st	High	5	.81
		Low	2	.41
	2nd	High	5	.78
		Low	2	.38
	3rd	High	5	.52
		Low	2	.25
Four periods	1st	High	1	1.16
		Low	0.25	.50
	2nd	High	1	1.02
		Low	0.23	.38
	3rd	High	1	.81
		Low	0.23	.25
	4th	High	1	.40
		Low	0.23	.13

Employees might be allowed to take insurance up to 80 or 90 per cent. of their regular income, and the secretary or sick committee be depended upon to see that fair play is accorded.

Temporary disability benefits of one dollar per day seem to be by far the most popular among average wage earners. Some apprentices may desire a lesser amount and many employees may want more, so that to please all, some plan might be provided whereby one might apply for any amount within certain limits.

In the Dodge Association, four different benefits, $0.50, $1.00, $1.50 and $2.00 were offered under the new by-laws, but due to a bump of caution on the part of the committee that decided on the by-laws, the rates were not made pro-rata, but were advanced on the larger benefits to guard against possible losses on this class of risk. The rates are as follows:

Daily benefit	$ .50	$1.00	$1.50	$2.00
Dues per week	.05	.10	.175	.25

In booking new members during the first year of the new by-laws no suggestions were made as to the amount of benefit each should choose. Many selected benefits so low as to be of relatively little benefit to them when compared with their wages. Since the first year an effort has been made to induce members to carry at least 50 or 60 per cent. of their average wage. To how what can be accomplished by salesmanship as against the natural tendency see Chart No. 14.

PROBLEM NUMBER 49

WHAT IS A PROPER BENEFIT FOR PERMANENT DISABILITY?

Twelve per cent. of the associations pay benefits for permanent disability, but only one-third of these, or 4 per cent. include cases arising from sickness. One-fourth of one per cent. of the members of associations paying permanent disability received these benefits in one year and the average cost was 48 cents per year for each member of such association.

Workman's compensation covers the accident insurance field only so far as applies to accidents while at work. The cost to an association of carrying permanent disability benefits for accidents when off duty should be less than for those occurring while on duty.

By paying temporary disability benefits for both accident and sickness, the associations cover loss of time due to permanent disability while payments continue.

The dismemberment cases such as, fingers, toes, hands, feet, eyes, etc. (usually meant when permanent disability is referred to in reports of the associations), often permit some degree of wage earning. These are now very well compensated for through workmen's compensation when due to work accidents and might well be eliminated here except so far as they may be embraced in the payments for temporary disability.

Permanent disability then will, for our purpose, consist solely of cases literally entitled to the name, and it certainly seems the humane thing to provide means for taking care of men when thus unable to take care of themselves, by prolonging the temporary disability period as explained in Problem Number 38. The charts in the fifth group of problems to appear next month show weekly dues necessary for various benefits during the first year. Assuming that all members of an association are paying dues sufficient to cover disability up to 52 weeks, it would be necessary to add only 2 cents per week to such dues to permit the payment of 25 cents each weekday so long as a member remains totally disabled after the end of the 52 weeks. Of course, to provide any multiple of 25 cents per day all members must pay the same multiple of 2 cents per week in dues.

PROBLEM NUMBER 50

WHAT IS A PROPER BENEFIT FOR DEATH OF A MEMBER?

Ninety per cent. of all associations have some form of death benefit. Of these, 76 per cent. pay a specified sum; 10 per cent. pay the amount collected from a specified per-capita assessment; 2 per cent. have assessments, but limit the amount of benefit while 12 per cent. are indefinite or make combinations of flat rates and assessments or have conditional benefits.

Of the associations paying a specified lump sum, 78 per cent. pay a uniform benefit for all members; 16 per cent. have two classes; 5 per cent. have three classes; the remaining 1 per cent. have four, five and six classes.

The benefits range from $10 to $1000, but the predominant ones are $50 and $100.

Some of the associations pay a larger amount for death from accident on duty than for death from accident when not on duty or from natural causes. In other associations the rate of wages or length of membership governs the amount of benefit. Personally, I cannot see why the amount of protection should be influenced by the cause of death, the widow needs the money just the same in any case.

Associations having two classes pay approximately twice as much for first class as for second class members; those with three classes pay in the relation of 50, 30 and 20. Table 5 shows the death benefits.

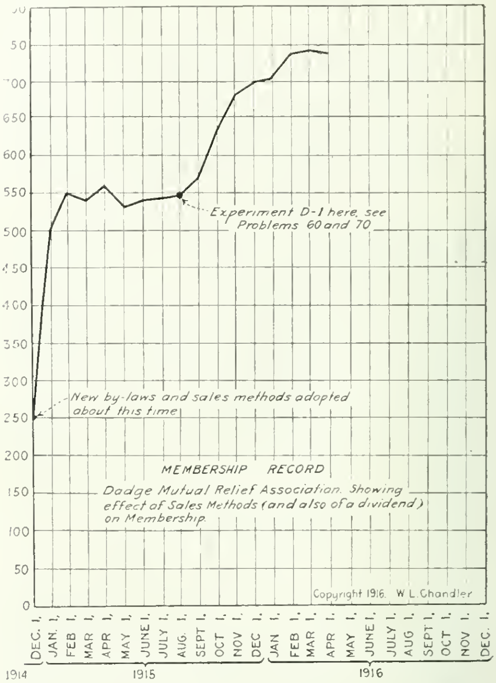


CHART NO. 14. EFFECT OF SALES METHODS ON MEMBERSHIP

Of associations paying by per capita assessments or other methods, it is impossible to tabulate the amounts and to arrive at the total amount of benefits without more research work than is warranted.

Thirteen per cent. of associations having death benefits use assessments in some form; four associations pay either $40 or $50 from their treasuries and the proceeds from assessments of $1, $1.50 or $2. The lowest assessment reported is 10 cents and the highest $2; 27 associations have $1; 16 have 50 cents; while 15 range from 10 cents to $2; 7 associations limit the amount to be derived from assessments to amounts from $50 to $100. Two associations pay funeral expenses only, while 11 pay benefits ranging from three to twelve months wages. Assessments destroy enthusiasm and therefore should not be used.

Four hundred nineteen associations paid, in one year, 2197 benefits for deaths, amounting to $460,838.51, the average being $209.76. The membership in these associations averaged during the year 318,892, making the average expenditure for the benefits due to death $1.45 per member.

As stated in Problem Number 40, the death rate per 1000 members was 6.7. In the industries each represented by 10,000 or more members, the death rates were as follows: Iron and steel rolling mills, 6.7; machinery, 6.5; coal mining, 5.6; street railway, 8.8; wholesale and retail stores, 5.5.

The death benefit seems quite generally to be intended merely for burial purposes, and when so intended the proper amount should be determined by the cost of a funeral such as the member's family would choose.

Now-a-days, $100 does not cover the expenses of the average funeral such as members select, but it is the amount of benefit usually chosen, and a funeral, if necessary, can be had for less than that amount. Dues of 2½ cents per week will cover a death of $100 with a factor of safety of 33 per cent., using the general average of the United States as a basis, provided enough members participate to give average experience.

TABLE 5

DEATH BENEFITS OF ASSOCIATIONS PAYING LUMP SUMS

Associations having only one class

Amount of Death benefit	Number of associations
$800	1
500	3
250 to 300	10
200	9
150	14
108 to 125	3
100	77
60 to 75	31
40 to 50	92
25 to 30	6

Death benefits less than $50 seem to be too small to be of much real use.

ASSOCIATIONS HAVING TWO CLASSES
AMOUNTS ARE SHOWN INDEPENDENT OF CLASSES

Amount of Death benefit	Benefit shown is found as one of the two in the following number of associations
$500	1
250 to 300	2
150	5
112 to 125	2
100	22
75	14
56 to 63	3
50	28
40 to 45	4
30 to 37.50	11
15 to 25	10

ASSOCIATIONS WITH THREE OR MORE CLASSES
AMOUNTS ARE SHOWN INDEPENDENT OF CLASSES

Amount of death benefit	Benefit shown is found as one of the three or more in the following number of associations
$1000	2
750	1
450 to 500	3
250 to 300	2
200	4
150	2
125	2
100	10
75	6
65 to 70	3
50	13
40 to 45	2
30 to 35	3
15 to 25	9
10 to 12.50	5

The experience of the Dodge Association indicates these rates to be safe. One Dodge plan is in successful operation whereby, upon the death of a member or dependent, the secretary confers with the beneficiary and with her consent pays the undertaker at once and secures a ten per cent. cash discount on the cost of the funeral, a satisfactory arrangement for all parties.

TABLE 6

DEATH BENEFITS IN ASSOCIATIONS WHICH PAY ON A UNIFORM BASIS FOR ALL MEMBERS

Death benefit	Number of associations	Membership	Total death benefits paid in one year	Amount paid during year as average per member of association
$800	1	1,787	8,000	4.48
500	3	6,025	13,000	2.16
300	5	11,880	32,460	2.73
250	5	3,702	6,500	1.76
200	11	9,994	11,600	1.16
150	15	13,926	18,200	1.31
125	2	2,325	2,125	.91
108	1	180	108	.60
100	77	38,606	29,679.05	.77
75	26	7,071	7,500	1.06
60	5	1,776	1,200	.68
50	87	25,880	8,000	.31
40	5	571	147.25	.26
25	4	291	100	.34
50 plus ass'm't, $2 per member	1	282	654	2.32
50 plus ass'm't, $1.50 per mem.	1	441	1,385.50	3.14
50 plus ass'm't, $1 per member	1	58	109	1.88
40 plus ass'm't, $1 per member	1	139	411	2.96
Assessment, $2 per member	1	68	268	3.94
Assessment, $1.50 per member	1	186	279	1.50
Assessment, $1 per member	25	5,909	32,266	5.46
Assessment, 50c per member	14	7,294	23,869.64	3.27
Assessment, 35c per member	1	354	254.45	.72
Assessment, 25c per member	5	1,631	707.24	.43
95 per cent of amount raised by an assessment of 25 cents per member	1	211	181.88	.86
Assessment of 25 cents per member, wife and child	1	107	98.75	.92

Note: Compiled by United States Department of Labor.

PROBLEM NUMBER 51

HOW SOON AFTER JOINING SHOULD A MEMBER BE ELIGIBLE FOR DEATH BENEFIT?

In 54 per cent. of the associations paying death benefits, a specified period of membership is required before members are entitled to such benefits, but in the remaining 46 per cent., members are eligible at once. In 83 per cent. of those managed by establishments, 41 per cent. of those managed by employees and 52 per cent. of those managed jointly pay death benefits without such restrictions.

TABLE 7

LENGTH OF MEMBERSHIP REQUIRED TO ESTABLISH TITLE TO DEATH BENEFITS

Length of membership required	Number of associations
Pay death benefits at once	192
Require 2 weeks	4
Require 30 days, 4 weeks or 1 month	75
Require 6 weeks	2
Require 60 days, 8 weeks, or 2 months	25
Require 90 days, 12 weeks or three months	55
Require 13 weeks	2
Require 4 months	2
Require 6 months	38
Require 9 months	1
Require 1 year	5
Scattering	18

Except in occasional cases 30 days afford ample time in which to determine the presence of diseases which might have been present due to infection or other causes at the time of joining. Therefore, a member should be eligible in not to exceed 30 days after joining.

See Dodge by-laws, Art. VIII, Sections 10, 11, and 14; also Art. III, sections 10 and 11, as follows

> Sec. 10. Members shall be eligible for sick and death benefits after thirty days from the date of their becoming members. In the event of a member later taking additional benefits such additional benefits become effective at the expiration of thirty days from the date of collecting the increased dues.
>
> Sec. 11. Benefits shall be paid as promptly as possible after the required proof of claims, but the directors shall have power to stop or withhold benefits in the cases of members who are able to work or are otherwise found to be imposing on the association.
>
> Sec. 14. No benefits shall be paid for disability resulting from ailments existing prior to joining the Association, unless specifically accepted by the Directors at time of joining.
>
> Sec. 10. In case that it shall be found that an applicant, his wife (or dependent husband) or a child, has a chronic or other ailment which would decrease the desirability of the applicant as a member, the applicant may, by a majority vote of the Board of Directors, be admitted to membership by exempting the Association from liability for such ailments or from liability due to ailments for which such conditions shall be responsible.
>
> Sec. 11. Whenever an applicant is admitted to membership in accordance with Section 10, the action of the Board of Directors shall be recorded on the membership record as well as in the minutes of the meeting.

Problem Number 52

What Benefits Should Be Paid for Death of a Member's Wife?

Twenty-two per cent. of all associations have such a benefit. These associations have 65,889 members and the average cost per member, (all members paid the same dues) was 25 cents per year. Eight per cent. of these associations pay $100; 6 per cent. pay $75; 58 per cent. pay $50; 6 per cent. pay $40; 12 per cent. pay $25. A few pay actual funeral expenses not to exceed a certain amount, others have per capita assessments.

Losses due to deaths of wives were at the rate of 3.7 deaths per thousand members of the associations providing such a benefit, the average being $63.19.

As a rule, the benefit for death of a wife is approximately half that for death of a member of the same association. This sort of benefit aids in decreasing worry, thus increasing the mental and physical efficiency of its members.

If these figures are a safe guide, an association could provide a $50 benefit for death of a wife, adding say 40 cents per year to the dues of each member. Single men have raised some objection to this plan whereby they must pay the same dues as married men without any prospect of benefit.

The Dodge Association provides for optional benefits covering wives, with corresponding increase in dues. (See Art. III, Sec. 3 and Art. VIII, Sec. 3, Problem Number 17 in February INDUSTRIAL MANAGEMENT.) Inasmuch as this increase in dues applied only to members exercising the option, the rates were made high until enough experience develops to point the way to more equitable rates.

The adequacy of these rates has been shown by a comparison of expense ratios and premium rates with those of stock insurance companies.

For a benefit of $100 at death of wife, the Dodge rate of five cents per week equals $2.60 per year, as compared with $.50 the average cost of the United States for the same amount of benefit covering cases where all members pay the same dues.

The introduction of these benefits increases the service to employees, and thus increases the usefulness of the association to the employer and affects turn over.

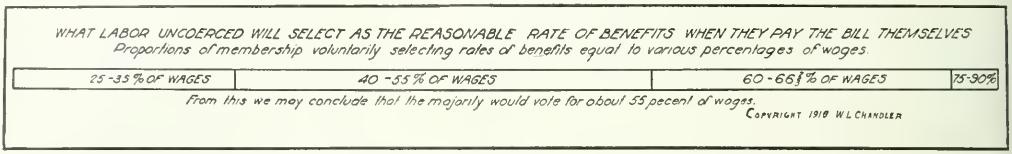


CHART NO. 15. SHOWING PERCENTAGES OF BENEFIT RATES VOLUNTARILY SELECTED BY EMPLOYEES

Problem Number 53

What Benefits Should Be Paid for Death of Other Dependents of Members?

Fifteen per cent. of all associations have such benefits with an average cost of 28 cents per year per member regardless of whether member had children or not. This covers a membership of 44,381. These benefits range from $10 to $100 and usually are paid for deaths of such dependents as child, father, mother, brother or sister. In the case of dependent children, the benefits are usually graduated according to age, from stillborn up to 21 years. Benefits for death of children vary from $10 stillborn up to (in one case) $100 for a daughter in charge of the household of a widowed member. The usual limit for children graduates up to about $25 at age of 8. For death of dependent parents, the majority of associations pay $50, the average benefit being $43.46. These benefits on the average were paid to six members in each 1000, being about the same rate as for members themselves. (The remarks on industrial insurance under problems 42 and 52 apply here also.)

The rates shown in the Dodge by-laws (Art. VIII, Sec. 3), are 4 cents per week or $2.08 per year for a $50 death benefit for a child between the ages of two and 16 years. These benefits are optional and consequently the rates apply only to those carrying the insurance, and are necessarily higher than they would be if each member paid these dues. The rates were prompted by a sense of caution at the time of their adoption. They may be lowered in the future. The average cost of all the associations was 28 cents per year or about one-half cent per week, indicating that if each member paid one cent per week, the association might safely pay $50 at death of each dependent child under say 16 years of age.

Comparison with industrial insurance rates indicates that the Dodge rates are high.

Problem Number 54

How Much Time Should Be Required to Settle a Death Claim?

The time required to settle death claims varies from immediate settlement on receipt of proof of death to 60 days thereafter. Some pay part at once and balance in deferred payments.

There is no excuse for delay. The secretary should be in touch with all sick members and through well members is able to determine the validity of any but the most exceptional claims. Promptness in paying claims is of the greatest benefit in increasing membership, and should be made a standard practice.

Problem Number 55

Should Death Claims Be Contestable?

In most associations, the conditions that cause forfeiture of rights to death benefits are practically the same as those causing forfeiture of temporary disability benefits presented in Problem Number 56. Regulations, however, do not appear to be as rigidly enforced in the case of death benefits, and a few associations having provisions for forfeiture of temporary disability benefits, have no corresponding restrictions as to death.

If the conduct of any member is not satisfactory to the association's management, they should adjust the difficulty or expel him before the death claim could become a possibility, or take their medicine and pay the claim. The death benefit is intended for the widow or children who are left; they should not be deprived of their rights at the last minute.

Problem Number 56

Should Members Drawing Disability Benefits Be Subject to Supervision or Restrictions?

Nearly all associations provide some sort of supervision over beneficiaries; 42 per cent. of associations paying temporary disability benefits require physician's certificates, while 25 per cent. provide that they may be required. Sixty-two per cent. have committees which visit all beneficiaries at stated intervals, making supervision double for members of those associations having both physician's certificates and committee reports.

Associations requiring medical examinations of beneficiaries seem to be about equally divided between weekly and tri-weekly examinations, with a few daily and some "as deemed necessary." When an association employs a regular physician, his certificate is required independently of any other physician who may be in attendance. A few associations provide that out-of-town members shall supply sworn certificates of physicians.

Many associations place restrictions on members while they are drawing benefits. The following restrictions were found in different associations; they must not be out at night; absent from home without consent of visiting committee; intemperate; found in a saloon longer than 15 minutes at a time; or guilty of improper or immoral conduct. Other restrictions are that members must not gamble; spend money for liquor; frequent saloons or disreputable places; prolong disability through misconduct; attend to any business; engage in any gainful occupations, etc., etc.

Nearly all of the associations provide that benefits shall not be paid when the disability is caused, or, in some cases, aggravated by intemperance or immorality. Some associations exclude cases for reasons such as disability existing prior to membership; cases arising from carelessness; fighting; scuffling, athletic sports; unlawful acts or misconduct; cases where fraud or attempted fraud is evident; where disability is not reported promptly; absence from duty without permission; failure to notify of change of address; refusing medical treatment; self-inflicted injuries; violation of establishment rules; and bringing suit against the establishment.

In 80 per cent. of the associations paying temporary disability benefits, memberships may be retained by disabled members who have exhausted the periods of temporary disability benefits allowed by the association thus retaining the right to any other kind of benefit the association may confer. This is usually on condition that dues and assessments be kept up, but some associations relieve members of this class from such payment.

A number of associations provide that membership shall cease at the expiration of the maximum benefit period or within a short time thereafter. It is important here to preserve the rights to any death or other benefits. Some deduct dues and assessments for such intervals from death benefits when paid. See Dodge by-laws, Art. VIII, Secs. 5, 6 and 7.

> Sec. 5. When no wages are due a member from the company dues must be paid when due, without solicitation from the Secretary in order to retain membership, except that in event of a member otherwise eligible for membership being temporarily laid off by the company, the Directors, upon request and satisfactory assurance of credit responsibility, may arrange to extend the membership for a period not to exceed thirteen weeks, when the amount in the treasury will warrant it and on condition that all such accrued dues are paid up.
>
> Sec. 6. When members have been laid off temporarily, and then resume work after having had the advantages of protection as covered in Section 5, whether receiving benefits or not, their dues shall be doubled until all indebtedness to the association has been paid.
>
> Sec. 7. The provisions of Sections 5 and 6 are available only to members who continue to reside in the same county, and do not take up any occupation, which, in the opinion of the Directors, should enable them to pay their dues, or should warrant the association in cancelling the membership.

A few associations paying benefits for a total number of weeks in one year provide that a member shall return to work for a stated period before being eligible again. See Dodge by-laws, Art. IX, Secs. 3, 4 and 5.

> Sec. 3. A member must remain at work at least four weeks after receiving a full term benefit of thirteen weeks before he is eligible for another temporary disability benefit for sickness.
>
> Sec. 4. Only one benefit, not to exceed thirteen weeks, shall be paid for one disability or for any one chronic disease or recurring disability.
>
> Sec. 5. Disability beginning less than four weeks after a previous disability shall be considered as part of the former disability unless there is positive evidence to the contrary.

While associations generaly refuse benefits in case of immorality, 5 per cent. specifically enumerate venereal diseases as causing forfeiture of rights. Ten per cent. of the associations paying temporary disability benefits report no provision for the forfeiture of these rights. While venereal diseases are such as may tempt us to taboo benefits, they are never contracted merely for the purpose of drawing benefits, and may be subject to benefits as much as any other disease.

The matter of malingering is extremely important and requires constant vigilance on the part of the association officers. The most successful way to guard against this point is to enlist the enthusiastic coöperation of the entire membership. A member will have a hard time pulling the wool over the eyes of all his fellows, especially those living near him. Many men who would beat the street car company out of a nickel would never stoop to take a similar advantage of the baseball team of which they were members. The association must secure on the part of all members that same feeling of loyalty that is enjoyed by the ball team.

Dividing the city into wards and districts and selecting members for visiting committees from the districts in which disabled members live has done much to reduce malingering for the Dodge Association.

Problem Number 57

Should Beneficiaries Have the Right of Appeal?

If a beneficiary is dissatisfied with the decision of the board, committee or officers who pass upon claims, most of the associations provide for an appeal, either to certain officers, to the managing board, or to the association itself.

The courts have condemned the plan whereby a member agrees in his application to abide by the decision of any committee or officer as being a final verdict without recourse.

(To be continued)

Mastering Power Production--IV.

Relations of Wages and Bonus to the Labor Problem

By Walter N. Polakov

This fourth installment begins the discussion of the labor factor in power production. The economics of wages is presented and the underlying philosophy of bonus is given from both the economic and psychological aspects. Finally there is a brief discussion of the influence of physical surroundings upon the efficiency of labor. A chart gives a comparison of the rises in living cost and wages since the outbreak of war.

Mr. Walter N. Polakov *is a consulting engineer specializing in the management of power plants. He was educated in Russia and Germany and held a position of shop superintendent and chief engineer in Russia and was also instructor and consulting engineer to the Naval Academy at Baku. After coming to this country, and prior to taking up his own practice, he was consulting engineer to the Board of Estimate and Apportionment of New York City, consulting engineer for the Penn Central Light & Power Company and Superintendent of Power of the New York, New Haven and Hartford Railroad Company.*

A SHORT time ago one of the captains of industry[1] dared to make a frank admission that the men of the working class, that is the men without property are going to dominate the world. "I am one who has come to a belief that the worker will rule," said he, "and like all revolutionary movements it will work good. The sooner we realize this the better it will be for our country and the world at large."[2]

Considering the labor problem, insofar as it enters into our study of power production, this spirit must be reckoned with as it is not so much the past as the future economic situation which must be plainly understood if the gravest of all problems is to be solved.

Economic Aspect of Labor Problems

To understand the true nature of the so-called labor problem one cannot avoid a brief review of the economic relations between employee and employer. While one group of society possesses the means necessary to carry out production, the other owns nothing but the labor-power, and its members live only so long as they can sell their capacity to work by brains or muscles and can find work only so long as their labor increases the capital.[3]

Abraham Lincoln said in a speech in 1847, "To secure to each laborer the whole product of his labor, or as nearly as possible, is a worthy object of any good government."

In the case of slaves, part of their labor was used to produce enough for their own maintenance, but all the labor seemed unpaid; with a serf-peasant who worked part of the time on his landlord's field and the other part on his alloted farm, this division between paid and unpaid labor was clearly separated; in the modern wage system, the division becomes so obscure that it appears to a superficial observer as if all labor is paid.

Value of Labor in Power Plants

Manifestly this is not so. The value of electric power for instance, is composed: First, of the value of fuel and other materials consumed in course of production; second, of the obligations to money lenders, landlords, wear and tear of machinery, etc.; and, third, of the value of the labor of all the employees. Obviously the entire cost of materials and all the other charges reappear in the value of power.

The fact, however, is that labor power, as any other commodity, is priced not by its use-value but by the cost of its production. Wages, therefore, are determined by the labor time necessary for production and reproduction of this labor-power.

As in the case of a power plant, the cost of production of human energy, both mental and physical, is composed of three main groups of expenses:

(a) Means of subsistence (operating expense). This must be sufficient to maintain the employee in his normal state, i. e., to reproduce between the working hours the energy discharged while working, by means accepted as a standard of living.

(b) Cost of reproduction of labor (maintenance and sinking fund). As men are withdrawn from use by wear and tear and death, the labor power must be continually replaced from the ranks of the new generation and sufficient means must be provided to raise and bring up the children.

(c) In order that employees may acquire the necessary skill in a given branch of industry, special education and training is required (fixed charges and administration) and means must be provided to cover the expenses of education and the accumulation of experience. A certain margin must also be provided to cover the individual's duties toward the state, society and for insurance of one kind or another.

Inasmuch as the time for the reproduction of labor-power is the chief determining element, it is obvious that employers of wage-earners insisted on buying time. If they had to buy the quantity of brain or muscle energy, or the result of work, the difference between the cost of labor-power and its use-value would vanish and profit from employment would disappear.

Forms of Wages

Having this point clearly in mind let us glance at special forms of compensating for labor. When wage earners realized that all they were getting was the cost of production of their labor-power, they bent their efforts on getting their price in a minimum time. Less than a hundred years ago even children had to work 16 hours a day in England. But the pressure of legislation, as well as the realization by employers that the less overworked man can produce more and better work, cut the working day almost in two. The employers, on their part, while yielding to a reduction of working hours, attempted to increase the productivity of labor per hour so as to offset the loss in time. Piece rate payment was introduced with that end in view. But, since men are not created equal in their capacity for work, some succeeded in earning far in excess of what was considered sufficient for the existing standard of living. Hence, the retrograding levelling process set in of cutting down the piece rates to the figure of the average daily wages. In this way the most vigorous and skilled men were lowered nearly to the old amount of earnings though for a larger output, while less skilled or physically weaker ones were reduced to starvation wages.

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[1] Mr. C. M. Schwab of the Bethlehem Steel Corporation.

[2] *Evening Sun* and *New York Times*, January 25, 1918.

[3] Cardinal Bourne, Archbishop of Westminster, said in his pastoral letter of February 19, 1918:

"The effect of competition uncontrolled by morals has been to segregate more and more the capitalist from the wage-earning class and to form the latter into a proletariat, a people owning nothing but their labor power."

In the field of power production the day wage reigned exclusively because there was no convenient piece measure by which the engineers and firemen could be rated. At the same time in this industry, clearer than in any other, it can be observed that the use-value of labor is never considered as a basis for determining the wages.

An Illustrative Example

Let us take a case of two firemen, one generating 1000 pounds of steam in a certain boiler with 100 pounds of coal, and another 1000 pounds of steam with 150 pounds of the same coal in the same boiler. The first fireman consumes eight tons of coal worth $40 in his watch, while the second uses 12 tons worth $60 to produce the same amount of steam; the first fireman should thus get $24 per day and the second only $4 per day, if their work were paid on the basis of its value in producing steam. It is small wonder, therefore, that such and similar ways of reasoning are often heard among those wielding the shovels, and that it offers the strongest argumentation in favor of an adequate and correctly established method of bonus payment.[4]

The "Equal Pay" Error

The antiquated, unscientific way of thinking is responsible for the misconceptions on the subject of wages common to many employers and labor organizations. While some economists obstinately insist that the profit is not due to the difference between the value of the labor and its price as a commodity, but to some mysterious process of autogeneration of capital, some labor organizations, justly protecting the minimum wage scale, raise all kinds of objections against higher pay to more skilled members. The "equal pay" error must have no place in industry based on coöperation. *The right of the producers is proportional to the amount of work they furnish; the equality consists in that the labor is measured by an equal standard.*

Special features of bonus payment will be dealt with at length later, suffice it to say here that while this method of payment for services rendered has as a basis a guaranteed amount (at least equal to the accepted standard daily wage) insuring the minimum living expenses, the supplementary payment of bonus proper is commensurate to the value of the services rendered. *The principle established is equality so far as the bonus is measured by a definitely standardized task.* Moreover, in the power house there is no place for objections to "speeding up," "sweating out," "undermining the health," etc., for the simple reason that better work or higher efficiency is attained only when the amount of physical work is reduced. In other words, higher efficiency of firemen means less coal burned for the same output, less ashes removed, etc.; higher efficiency of engineers or switchboard operators means merely closer attention to the instruments showing the distribution of load, vacuum, etc. Higher efficiency of the maintenance men means reduced work under strenuous conditions of emergency repair, which is displaced by preplanned inspections, etc.

Universal Labor

What has been said about so-called coöperative labor, which may be defined as a direct coöperation of living, working individuals, is preëminently true regarding universal labor or scientific labor such as leads to discoveries, inventions of new methods and means. This labor is conditioned on the coöperation of living fellow beings and the labor (and ideas) of those who have gone before. The greatest benefit is usually derived from exploitation of this latter labor of human mind and its coöperative application in society. Through the work of this class of men intensive production was made possible and enormous wealth accumulated, while they themselves, trained engineers, inventors, scientists and organizers, are not better off today than they were years ago and certainly comparatively worse than the men working manually. The application of scientific discoveries and methods to industries, the introduction of labor-saving machinery, etc., lavishly contributed to the intensification of production and increased the productivity of labor. Yet, as in the introduction of power looms, coöperative labor did not take kindly to the work of universal labor. The viewpoint of the working class was plainly stated some two scores of years ago in these words of A. Bebel:

> Everyone in practical life knows with what suspicion the working man today regards every improvement, and every invention introduced into the shop. And he is right. He rarely derives any advantage therefrom; it all accrues to the employer. The workman is assailed with the fear lest the new machines, the new improvement cast him off tomorrow as superfluous. Instead of gladsome applause for an invention that does honor to man and is fraught with the benefit to the race, he only has a malediction on his lips.

The fallacy of such an attitude would be obvious if competition were replaced by cöoperation, since such increased productivity would make possible the satisfaction of higher wants.

Increased efficiency must, therefore, be properly directed before it becomes a real boon to society, as all these wonderful creations of engineers and scientists might easily become the accursed means of destruction and oppression of one part of the society by another.[5]

Results of Intensified Production

The sad experience of our pre-war period taught us a lesson that so long as scientific methods of intensifying productivity were monopolized for privilege, not for public weal, the period between industrial depressions due to overproduction shortened, the army of unemployed increased, and the purchasing capacity of the people dropped for the cheapening of production in individual plants did not affect the market prices at large, and a lowering of the physical standard of workmen, prostitution, and birth-control gained headway.

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[4] Cardinal Bourne, quoted before, said: "During the war the minds of the people have been profoundly altered. Dull acquiescence in social injustice has given way to active discontent. The very foundation of political and social life—our economic system—is being sharply scrutinized, and this not only by a few writers and speakers, but by a very large number of people in every class of life, especially among workers."—*New York Times*, February 19th, 1918.

[5] "While the constitution [English] had increasingly taken on democratic forms the reality underlying those forms has been increasingly plutocratic." Cardinal Bourne. *De te fabula narratur!*

Mr. Ledoux in his presidential address before the Engineers' Club of Philadelphia called attention to the fact: "That the wealthiest two per cent. of the people of the United States receive almost as much income as the poorest 50 per cent., and they own far more wealth than the other 98 per cent. Under such condition, when five per cent. of the population has approximately almost the entire national wealth, leaving but little to the other 95 per cent., the talk of democracy is but "sounding brass and tinkling cymbals."

That things have not gone better since this was written may be gathered from such reports as this of the Director of the Bureau of Child Hygiene. Department of Health, New York, according to which in 1916, 100,000 or 10 per cent. of the school children were underfed, while in 1918, 21 per cent. of the school children in this prosperous city are undernourished and 61 per cent. are on the border line of being underfed. Again, when our Federal Trade Commission admits that some 78 per cent. of our business corporations are managed so as not to get (or show) any profit, it means that they can not properly take care of their employees, it means that lowered productivity of labor is as inevitable as waste of fuel and inefficiency when a plant is run with poor equipment and improper methods.

Relation of Price of Labor and Cost of Commodity

The task of an engineer has been often defined as that of securing a maximum product for a dollar's worth of expense. We feel that in order to make this definition correct we must put some capitalization on each man capable of working and charge against the national debit every hour lost through mismanagement, lack of work, lack of skill, sickness, discontent, poor nourishment or poor transportation.

From this broader, national standpoint only we may hope to realize the true meaning and enormous value of the so-called "industrial paradox" which was formulated in 1865 by the General International Congress, "*that high-priced labor may produce cheap, and low-priced labor may produce dear commodities.*"

Gantt and other industrial organizers have since discredited the fallacy that it is necessary to have low wages in order to have low costs, which are detrimental to all concerned.[6] On the other hand the increased productivity of labor under the condition where production is carried out not for the benefit of the entire community or the country but merely for private gains of a possessing group, makes the laborer feel that he has nothing to gain. Furtherfore, *the old school of management, seeing little beyond the trial sheet of accounting balance and knowing no royal road to eliminate mismanagement, tried to recover the losses by increasing exploitation of labor.*[7] The high ideals and honest intentions of Taylor's scientific principles were only too often misused and abused to a decided disadvantage of labor and doubtful gains to manufacturers themselves.

While these lines are being written, President Wilson's Mediation Commission published its finding: "The conclusion cannot be escaped that the available man power of the nation . . . is not employed to its full capacity *nor wisely directed.* . . Broadly speaking, American industry *lacks a healthy basis of relationship between management and men.* At the bottom this is due to the insistence by employers upon individual dealings with their men."

The Limits of Wages

Whatever might be the ultimate agreement on the controversy of dealing with individual employees or bargaining collectively with labor unions, the same fundamental antagonism of interests will remain so long as employers conduct their business solely for profit and employees have no control of the means of production. The minimum wage, as we have shown is the cost of existence—the maximum is the full value of labor, i. e., when no profit is left for the employer. The dual position of a man as a member of the community and as an individual obviously suggest the double basis for wage determination. The constant part is a minimum wage scale arrived at as the result of bargain of the two opposing parties and representing the cost of living accepted in the community as a standard. A variable part of wages is the bonus figured out on a basis equal to all men engaged in the same task using the same implements and working under the same conditions but varying with individual attainments. Thus the principle of equality is approximated as nearly as possible inasmuch as under this plan equal opportunity is offered to all, equal basic pay is guaranteed to all in the same occupation, and excess pay is measured by the same measure and the bonus is proportionate to the value of the service rendered.

The Limits of Bonus

The volume or the amount of the bonus to be paid evidently lies between two limits: Maximum, when there is no profit left for the employer, and, minimum, when it ceases to be attractive to the employee. If the principle of collective bargaining advocated by the President's Mediation Committee is to be adopted, it is only logical to expect that the matter of methods employed for the determination of tasks (as a measure of bonus) and of the amount of bonus shall be made clear to both contracting parties. Unfortunately, the labor unions, realizing the necessity of having in their employ legal and administrative talents, are not awakened yet to the still greater necessity of submitting such matters to investigations by specifically trained engineers.

The problems involved in setting tasks for power-plant employees for instance, cannot be settled by mere debating and a discussion of opinions. The underlying facts cannot be obtained without a great deal of scientific research work. To establish beyond doubt their veracity and fairness, or to expose the contrary, requires much expert knowledge and intimate familiarity with the subject. Medical treatment is not decided by popular vote. Why should the health and happiness of wage earners be left to a similarly arbitrary method? To avoid any possible misunderstanding on this point, I must emphasize that, while the consent of labor is an indispensable pre-requisite for the success of any industrial readjustment (be it in methods, equipment or relations) this consent cannot and shall not be attained by arbitrary vote based on opinion and prejudice, but must be based on facts, indisputably established.[8]

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[6] It is not the lowest, but the highest-paid labor, with scientific management and machinery, which gives cheapest products. Andrew Carnegie.

[7] The workers . . . . . . subjected sometimes to *irritating mismanagement* and anxious about the future, tend to be resentful and suspicious of the public authorities and the political leaders. They [workers] too are questioning the whole system of society. Cardinal Bourne. Also see the President's Mediation Commission Report.

[8] Justice Louis D. Brandeis said: Labor must have throughout an opportunity of testing whether it is the whole truth. Labor must not only be convinced of the industrial truths—which scientific management is disclosing—but must also be convinced that those truths are consistent with what may be termed human truths. Is the greater productivity attained clearly consistent with the health of the body, the mind, and the soul of the worker? Is it consistent with industrial freedom? Is it consistent with greater joy in work, and generally in living? These are questions which must be answered in the affirmative, and to the satisfaction of the majority.

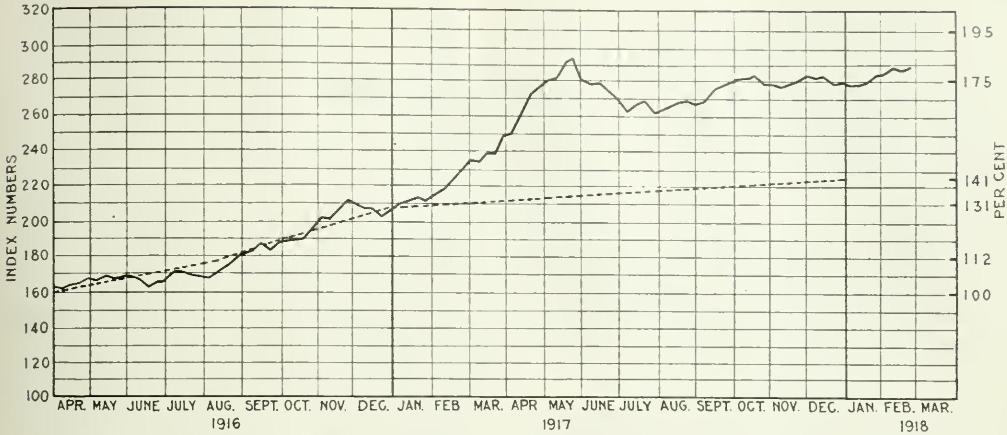

CHART 9. COMPARISON OF INCREASE OF COST OF LIVING AND WAGES FROM APRIL, 1916

The top solid curve represents average wholesale prices of 25 food commodities selected to represent a theoretical family's budget. (The Annalist of February 25, 1918). The lower, dotted curve represents the average increase of wages as reported by the New York State Industrial Commission.

THE PSYCHOLOGIC ASPECT

The most efficient machinery is of no avail unless properly operated. In the final count it is neither perfection of equipment, nor excellence of supplies, nor best of advice that produces best results, but the will of the men that control and operate the plant. The steam consumption of the most efficient turbine may be higher than that of a less efficient one if it is improperly loaded and run at low vacuum, low pressure and with saturated steam. All this is up to the operators. The most suitable coal in the best furnace, and under a perfect boiler may show lower efficiency than poor coal in any old kind of a boiler, if the draft is poorly adjusted, if the firing is irregular, heating surface dirty, etc. All this is again up to the operators.

The best of instructions may be available and all the facilities at hand to secure highly efficient results, but if the employees do not care to live up to them, the efficiency will remain low. In other words, *there is little use to know how to operate the plant to best advantage unless the operators are willing to do so.*

Any act of will can be analyzed to three distinct processes; first is a *preception*, next the *choice* and finally the *act*. One cannot act unless the choice is made as to how to act (Buridan's ass) and this decision cannot be reached unless some stimuli are stronger than others. Yet men are constantly under the influence of heredity, bringing up and environment. These factors naturally affect the preception, selection and action or, in other words, our will power.

If we admit with Laplace and Spencer the principle of sufficient reason in its limited sense, the logical conclusion would be the denial of freedom of will as every cause resolves itself into a single effect. The fallacy of such reasoning was first exposed by Prof. A. Petrunkevitch who proved that every cause is potentially capable of producing several effects, but that the number and nature of the effects which actually take place may vary within definite limits only, i. e., within specific amplitude of the cause. In mathematics, we find many examples where equations have several solutions, and the same effect may be produced by different causes as, for instance, the ellipses, parabola and hyperbola may be derived from

$$l = \frac{e\ p}{1 - e \cos \Delta}$$

where l and Δ are polar coördinates. Similarly,

$$4 = 2 + 2 = 2^2 = \sqrt{16} = 5 - 1 = 3 + 1, \text{ etc.}$$

Therefore, while it is indisputably true that every effect necessarily has a cause, we must admit that a cause may resolve into several effects.

BONUS STIMULATES ACTION

The great practical value of this conception is that in case of human will, perceptions will originate definite feelings and desires, while the choice between them is caused by conscious decision preceeded by reasoning. In our case of offering bonus for learning the best way of performing certain work, or living up to instructions describing how to regulate certain thermo-dynamic processes, it is not a foregone conclusion that any bonus will necessarily stimulate men to a predetermined action.

In this case we first must consider whether the reward is attractive enough to create desire: A concern offering 40 cents to firemen for learning how to save $15 worth of coal failed to get any response from men getting $4 per day for their habitual wasteful work, whereas men in another plant getting $3.75 per day were eager to learn how to save $8 worth of coal when offered 85 cents as bonus.

The second consideration is the conscious choice which sometimes presents a problem to men whether it is worth their while to get an extra attractive reward if there is any doubt in their mind as to the honest intentions of the employer. It may not be to the advantage of the men to earn bonus if they are reasonably sure that after a short time the bonus may be discontinued and disciplinary measures introduced to enforce the higher grade of work demonstrated as possible under a bonus incentive. Likewise, in cases where work requires physical exertion, a task set by an incompetent man may be so hard as to endanger his health. The choice in such a case will be negative as the dictates of reason will suppress the desire for extra compensation in favor of more remote benefit or preserved physical welfare.

THE PROCESS OF CHOICE

This process of choice of accepting or refusing the bonus offered, as caused by reasoning and natural inclinations of an individual, creates endless varieties in the readiness with which the men transmit their decisions into actions and promptness or slowness, as well as the persistence or indifference with which different men learn and continue to perform their tasks.

Furthermore, considering the bonus as an incentive or stimulus, one should not forget that the acquiring of a new habit for performing the work in the prescribed new and unusual manner is one of the most difficult psychological processes, and the inducement must necessarily be not only strong enough to influence the decision in favor of the new order, but also to overcome the inertia of old habits for a sufficiently long time to replace it with new habits and, what is not less important, with the new mode of thinking in substantially different terms. Like men who are trying to abstain from a smoking or drinking habit, in the beginning, the men under a new mode of management are working under a great nervous strain, and the more gradual the process, the more sympathetic and helpful the attitude of instructors and other members of staff, the easier is the process of acquiring the new habit and the more lasting and successful are the results.

The Change of Attitude

The following extract of two letters from the writer's file indicate the change in the psychology of those whom the writer had the pleasure to help in such a transition period:

> I wish you could continue these tests farther, for the reason that instructions to firemen during these tests have certainly proven to them that their way of firing is nothing better than ridiculous.
>
> You have broken some of their bad habits. . . . You have shown them some things that they thought were impossible. . . .

Now, such an admission requires a change in mentality hardly short of being revolutionary. It is human to resent, and the way to accomplish the change is not a criticism but a demonstration and conviction. This point is evidenced from another letter written by the employees at the close of the writer's engagement:

> While here, you have not only placed the plant upon a high plane of efficiency, but also by your kind and helpful way and your diplomacy have succeeded in dispelling every vestige of the hostility to your methods that some of us entertained.
>
> We feel that it must be a great satisfaction to you that you have accomplished so much, and at the same time gained the coöperation and friendship of the rank and file of the organization. It is significant that the workmen have been changed from doubters into enthusiastic bonus men.

The Physical Aspect

Men actually live in their place of work, and too much attention cannot be paid to hygienic requirements. Petty annoyances caused by lack of comfort distract attention from proper performance of work by occupying men's minds with schemes of avoiding inconvenience. Such elementary requirements as good, cool drinking water, comfortable baths, lavatories, dressing rooms, plentiful illumination free of glare and flickering, absence of cold drafts, good ventilation, restful seats, etc., are far more important than refinements in design and thermal efficiency of equipment. Tired, annoyed men, with distracted attention, will overlook or even cause greater losses than the difference in result between the best and the next best efficiency under improved hygienic conditions.

Still more important is the length of the working day. Numerous experiments prove that the same firemen working on the same equipment and using the same supplies are 4.5 per cent. less efficient on 12-hour shifts than on eight-hour shifts, and a further reduction of shift to six hours (four shifts in 24 hours) enhances the efficiency up to six to seven per cent. which more than twice covers the extra labor cost.

Some excellent work has been done recently on the effect of fatigue on the quality of men's work, on the accidents and on the health of employee and it is not the super-abundance of the milk of humanity that prompts advanced employers to eliminate these harmful causes. Physicians know the ill effect of fatigue toxins on the physical and mental faculties of men, and no management can secure the best results if it remains indifferent to the poisoning of employees' mind and body.

Again, the care of physical welfare of the employee should not be limited within the plant premises. Unhygienic habits of living, surroundings, influence of environment, means of communication, schools, means of recreation and like factors should be studied and remedied as far as possible.

The value of the physical welfare and contentedness of the employees, outside of its social importance, can be easily figured out in terms of dollars when one considers the loss due to frequent change of employee resulting in low efficiency and the added cost of training the newcomers. The following extract from a report of a mechanical superintendent of a mill which recently adopted the writer's principles bears witness:

> The human factor in this whole work is of a paramount importance. With present scarcity of labor, high rate of wages paid in other industries, and numerous temptations to quit and try luck somewhere else, we felt that no effort should be spared to make our employment as attractive as possible. We started our reorganization with building a service room for firemen with shower bath, lockers, benches, etc. We provided restful seats in the fire room with lunch shelves, drinking water bubbler, ventilating fans, etc. Better designed tools were developed, coal way remodeled, coal scales made automatic, etc.
>
> In this respect, our record warranted our efforts: since August [of last year], i. e., when we started task work with bonus, we lost only one fireman helper for family reasons, while previously to that the turnover of our boiler house employees exceeded 30 per cent. Moreover, the interest in the work has been aroused as is evident from many questions constantly asked now pertaining to the work, instead of the former monotonous, apathetic attitude.

To sum up, the immediate problem before the management is to ameliorate the antagonism of interests between employer and employee. This can be accomplished not through bargains and debating societies but by a thorough inquiry into the basic facts underlying economic and human relations. The accurate knowledge of causes and results gives the powerful and indisputable weapon to smash many fallacies and traditions that greatly harm both sides, yet have no other *raison d'etre* than a misconception that what was true yesterday remains so today.

(To be continued)

Service Badge

Rules of the Ross Rifle Company

(1) Each Badge has a number on the back and the worker in his factory bears the same number as the Badge, thus preventing unauthorized transfers, or wrongful possession.

(2) The employee must work for one employer for a period of thirty days before receiving the Badge.

(3) Service bars for continuous employment for a period of six months in the plant are provided by substitution of new Badges for old on the request of the employer.

(4) The system of paying hands always involving a holdback of from two to five days ensures the giving up of the Badge on final payment, in other words, no hand is paid off without delivery of the badge first.

(5) Misconduct on the part of an employee is reported, and the Badge withdrawn and a record of the same kept in the office, to prevent re-employment if possible.

Employment and Personnel Policy of Thomas A. Edison Interests

Employment, Rate-Setting, Betterment, Safety, Health

By Mark M. Jones

This article is the first of a series to show one of the highest developments of industrial employment work in the United States. The methods that will be described have proven a vital factor in the success of the plants of the Thomas A. Edison Interests—because they have held together in contentment a force of many thousands of workers in these critical times.

Mr. Mark M. Jones' *early experiences were gained in the employ of a street railway company in Waterloo, Iowa, including positions of street car conductor, general office work and chief clerk in a traffic department; later he became traffic manager of the William Galloway Company. Relocating in California he held several positions connected with traffic, finally becoming industrial secretary of the Oakland Chamber of Commerce. This position brought him in contact with the manufacturing problems of over* 600 *plants. In* 1916 *he undertook the organization of the Personnel Department of the Thomas A. Edison Interests at Orange, N. J., holding the position of Supervisor of Personnel. He organized the Newark Society for Study of Employment Problems. After the outbreak of war he became a member of the Committee on Classification of Personnel in the Army and has developed a system of specifications of trades and oral and performance tests for measuring the vocational ability of recruits.*

IDEALS are the rocks in the foundation upon which the personnel policy of the Thomas A. Edison Interests is erected. As a policy must be the embodiment of ideals, in building up our policy, we have concentrated on the crystallization and refinement of the main ideals of the Edison organization in those phases touching personnel.

While Mr. Edison always had a great appreciation for man power, and realized the possibilities of success with the job in the hands of the right man, the organization of a personnel department did not fit into the expanding Edison organization until it was inaugurated as one step in the development of the Edison divisional policy after the fire. It has been carried on under the direction of Mr. Charles Edison, Chairman of the Boards of Directors of the Thomas A. Edison interests. Mr. Charles Edison is the son of Mr. Thomas A. Edison, and has a keen interest in men. Under his guidance we have made some progress in our study of the fifth "M" in industry.

Elements of the Edison Personnel Policy.

A sympathetic, scientific study of the human factor in industry.

An effort to insure "one square deal" for ninety functions.

An endeavor to put ideals into practice, tempered by sound business judgment.

The substitution of leadership for drivership.

The extension of impersonal administration.

Development of executive control, which stands for control of the executive by himself as well as for control of functions.

A belief that if one is to err it should be on the side of the weak rather than on that of the strong.

The realization that it is better to apply old principles in a timely way before expending energy in discovering new ones.

You have often heard that the five main factors in industry are Men, Money, Materials, Methods, Machines. Most organizations have followed the line of least resistance in studying them, and have organized for the proper administration of money, methods, materials and machines, because those four factors were the most tangible. They have only set out to scientifically administer their personnel problems when forced to do so, or when they at last reached that point in the organization or reorganization of the particular enterprise. The most intangible M—men—has usually been left until the last, probably on account of being the most indefinite and least understood. It was not so new. It had been with us since the dawn of civilization and as a rule it had been so close that it had not been seen. It was lost in the pursuit of the other four M's.

The purpose of the management of the Edison interests to organize a personnel department was accelerated by the lessons of the fire. It was very clear that we had lost the material side of some enterprises, and while this proved a great loss, it was insignificant when compared to what our position would have been had our organization been lost as well. With personnel, we were in a position to reorganize quickly, rebuild and resume production in a few days. The value of personnel thus became strikingly apparent, and it then was clear that a specialized instrumentality should be provided for handling the interests of such an important factor. As a step in the setting up of a combined staff and line organization, the organization of a personnel department was started.

UNIFIED POLICY THROUGH CENTRALIZATION

We thoroughly appreciated the excellent things that had been done under individual managers of divisions, and it was not because their work had broken down that the administration of personnel was centralized in one staff unit, but rather in order that the best methods of each division might be more quickly extended for the benefit of all. Where the administration of personnel is left to function heads, an organization with separate units under one ownership often finds itself with as many policies as it has units. Centralization then tends to set up one policy, whether it be on personnel, purchasing, traffic, credit, or what not, and each unit gets the benefit of the widest possible experience.

In planning our organization, we considered that we were entirely ignorant on the subject and, therefore, made an extensive study of organizations then in existence in other American industries. We proceeded on the basis of that research to develop the Personnel Service Department of the Thomas A. Edison interests in the light of what we regarded as the most progressive experience up to that time.

"The sales spirit" is one of the fundamentals of the Edison divisional policy that has been held in sight at all times during the organization of the Personnel Service Department.

To Educate Not Compel

It has been our purpose not to force any of our beliefs or ideals upon a manager. While the various divisions of the Edison Interests were managed by men with a keen appreciation of justice, still it was believed that centralization would insure "one square deal" rather than the varying kinds that must of necessity come from an organization of a large number of men. A square deal depends very much upon the personality of the "dealer."

I hesitate to speak too much of "ideals" for fear of being judged as impractical or entirely idealistic. While we have never lost sight of our ideals we have always endeavored to temper them with sound business judgment.

It has been said that business and sentiment do not go together. We hear that there is no place for sentiment in business. But Edison experience has caused us to take the opposite view. It is our belief that there is more sentiment in business than ever before, and that its extension in the proper manner and on a broad scale will be one of the most potent factors in promoting national understanding and harmony. It is an important factor in securing coöperation, and if industrial America is to maintain its economic position in the world after the war, it must thoroughly appreciate the importance of substituting coöperation for competition, and thereafter follow the standard bearing the motto "Coöperation is the Life of Trade."

The Edison organization generally is required to substitute known facts for guesses, and is expected to use a full measure of reason in making certain that it is moving on the basis of known facts. Throughout our work we have, therefore, made it a point to focus the flow of information bearing on personnel in a manner that would properly reflect conditions and tendencies in time for intelligent use. We were confronted by a difficult problem in organizing adequate personal records for widely separated units, and so to maintain the flow of information as at all times to keep in touch with the ebb and flow of the human tide. The increasing importance of individual records has clearly justified our efforts in this direction. We do not by any means consider that we have achieved the ultimate in any respect, yet we have made some progress and have made our share of mistakes. We consider that we have simply made a start and expect to make still further progress in improving our service to the entire aggregation of Thomas A. Edison Interests.

Why We Say "Personnel"

We adopted the designation of Personnel Service Department as the most comprehensive name that might apply to the functions to be grouped under it. "Personnel" was a comparatively new word and one not understood by workers generally. Still it seemed to be the one term comprehending the functions grouped together, and was adopted although it was appreciated that considerable time would elapse before its meaning would be generally understood. Some progress has been made in this respect, although we still receive an occasional communication addressed to the "Personal Department." This is a minor point, but one of the many little things that we feel should be given consideration in organizing for the administration of personnel. After all, the motives of men are usually little things and we have endeavored to constantly hold in mind the old maxim that, "Great oaks from little acorns grow."

Our study of organization led us to the conclusion that if the Personnel Service Department was to fill its proper position in representing the management in its contact with men, it should have six primary functions.

1. Supervision.
2. Employment service.
3. Rate service.
4. Betterment service.
5. Safety service.
6. Health service.

It was apparent that centralization of these functions in one staff organization would be surrounded by the usual difficulties attendant upon a drastic change of that sort. The Personnel Department was established in a status coördinate with that of other functions and was set upon organization charts to report to the executive committee through the chairman of the board of directors.

Leadership Not Drivership

Our personnel department is sponsor for the movement to substitute "leadership" for "drivership." This is only consistent with democratic organizations and naturally would have no place in an autocratic organization where the supreme power rules by the power of his mind. It is pretty clear that the days of coercion are over, and that an executive, no matter how high he may be, cannot force a man to do anything. Commands are only for military organizations, and are fast being displaced in industries by the right sort of leadership.

An important cause of friction in the installation of a centralized personnel department, or any other centralized staff department, is the feeling on the part of foremen and department heads that power is being taken from them. This action is usually considered by foremen as a lessening of responsibility, but it is really the direct opposite. At no time in the history of American industry has the responsibility of the foreman been greater than it is today. He has no time for anything but leadership and should be only too glad to exercise the proper kind of specialized supervision needed in his department. If he will concentrate on instruction and coördination he will be able greatly to improve the results secured in his department. Industrial America is on the dawn of a new order of relationship between management and men, and the foreman or department manager must carry the burden in the development and extension of the principles underlying this new order. Such leadership is comparable and contrasted with the methods reported as followed respectively by Allied and German officers. The Allied officers are the first over the top and lead their units, whereas German officers remain behind after forcing their men over the top at the point of revolvers. One represents *leadership*, the other *drivership;* one policy is in the ascendant, the other will become extinct within the next decade.

It is apparent that while the able and efficient driver or autocrat accomplishes great results, he is often unable to resist the temptations surrounding success and contracts fatal laziness. He may then die, resign or disagree with the owners. In any case the efficiency of the organization promptly collapses. On the other hand the real leader works toward the coördination of the various elements, and the development of a sound business structure, one that endures regardless of personalities because organized on right principles. The principle underlying the old maxim "you may lead a horse to water but cannot make him drink" is coming to be appreciated in its application to the problems of management. The man who is moved by an understanding of the subject or, in other words, the man who is thoroughly "sold" achieves results far beyond those secured by the man who is commanded to perform a certain task and goes blindly about it. It is the same theory that underlies the policy of reform from within versus that from without.

Impersonal Administration

Another important point in the Edison personnel policy is that of *impersonal administration.* We expect every Edison executive ultimately to reach such a point in his own individual development that he may be able to give at all times impersonal and impartial consideration to any question, and cease to be a creature of emotions. American industry has long suffered from the inability of its executives to control their tempers, and this phase of business discipline is rapidly coming to be appreciated. In the heat of the moment executives often undo the work of weeks and months, and more often cause the organization to lose men of great value. Industry generally has suffered from too much dignity. We need thick skinned men who know how to control with their brains, and who are not upset by the least indication of individuality on the part of a worker. Impersonal administration stands for recognition on the basis of merit, and for that *poise* in the make-up of the executive that causes him never to act in such a manner as afterward to regret it. Organization stands for *control* and covers control of temper in personalities as well as control of methods. Industry needs faith and enthusiasm, and can only develop them through impersonal administration.

Responsibility and Authority

The same underlying motive causes us to speak of responsibility rather than authority. Most industries have had too much authority and, therefore, are suffering from the lack of a feeling of responsibility. It is not unusual to hear executives speak complainingly because "no one will take an interest," and, "I have to do everything." A little further investigation usually reveals that the particular function or enterprise where such complaints are heard is suffering from too much authority and its personnel, therefore, feels no responsibility. Executive control is without doubt a fine art, but it must not only mean control of the organization, but control of the executive himself. We believe that much has been accomplished toward bringing about an understanding of this among the function heads of the Thomas A. Edison Interests, and we look forward to the day when it will be still more generally understood and more clearly reflected in improved results. We regard it as simply a matter of everyone being human and feel that we are moving forward rapidly in that respect.

In the furtherance of that ideal it is generally understood in the Edison organization that no one man finally settles an important question. An executive profits from the discussion necessary to get another to agree with him and, in addition to preventing the errors of blindly driving forward, the practice strengthens the individual, through having fortified him with the confirmation of another individual of judgment. The practice naturally must depend upon circumstances and, where immediate action is an important consideration, a result must not be lost sight of through regard for the means. Often times an organization suffers through this very tendency manifested by some executives to forget the end in a consideration of the means.

Employee or Coworker

While it may possibly be considered a minor thing, still another of the little acorns from which the great oaks will grow is the spirit which prompts us to displace the word *employee* with the word *worker.* After all how many persons enjoy being thought of as an employee rather than as a coworker? It is one point in the development of a policy of leadership versus drivership. An important one, nevertheless! If one be in doubt on this let him think of himself as an employee rather than as a coworker and then consider which is the more satisfactory.

We have considered that the word welfare has been overworked and in the minds of many workers stands for charity. Our endeavors along these lines in the Edison organization are considered to be betterment work, and are designed primarily to help the individual to help himself. Again we go back to the book of maxims of our childhood and draw forth "easy come, easy go" in this connection. Benefits accruing from naught usually produce naught. The law of compensation works. The generally accepted meaning of welfare is something entirely different from that of betterment. Conditions should not be allowed to reach the stage where welfare work is necessary. Through betterment work the need for welfare work may be avoided.

The Edison personnel policy seeks to advance organized leadership rather than individual leadership. It stands for the *we* rather than the individual *I.* It naturally frowns on communications which bristle with I. In setting up our standards we have at all times endeavored to place ourselves in the position of the other fellow and "do unto others as we would have them do unto us." In arriving at our decisions we have felt it far better if we were to err that it be on the side of the weak rather than on that of the strong.

While we have made some progress in molding our ideals into a policy we do not wish to be understood as claiming to have evolved any particularly new theories or made any revolutionary discoveries, so far as administration of personnel is concerned. We were recently informed by an executive who had been rather backward in according us full cooperation that the Personnel Service Department was doing nothing new, but that its methods might be found in various other plants scattered over the United States. We quickly confirmed this statement as, after all, we do not feel that it is so important to discover new principles as it is to evolve timely methods of applying the oldest principles of civilization.

Knowledge of Things That Won't Work

In connection with our explorations we might be considered to be rich in knowledge of things that "won't work." We are very much in the position of the engineer who was experimenting for Mr. Edison. After spending many months and trying countless methods he at last come to Mr. Edison and said: "Mr. Edison, I am very sorry and very much disappointed to have spent all this time and money on these experiments and to have accomplished absolutely nothing." Mr. Edison is reported to have looked up for a moment in silence and then said: "Accomplished nothing, indeed! Haven't you accomplished important results? Don't you know the things that won't work?"

While our accomplishments may be rated somewhat higher than the results of this engineer, we naturally have had many problems to work out involving great difficulties and have discarded or rapidly outgrown numerous systems. We still have no small number of problems to solve and know many things that "won't work."

We hope that we may in time through organized leadership create in the Thomas A. Edison Interests a full measure of the spirit that existed in the days of small industrial units when the head knew every man working for him personally and was a real vital personality in his everyday life.

When American industry through the scientific administration of the fifth M—men—reaches the ultimate in the handling of personnel problems, we will be nearer to the day when our great enterprises prosper on the basis of mutual understanding, interest and respect. That is one instance where the end may be entirely lost sight of, and the means only considered. The end will there take care of itself. As one unit in American industry we are endeavoring to "do our bit" in organizing the means. This article has been written to show the principles underlying our policy and methods.

Graphic Control of Production and Cost

Examples from Practice Show How Charts Visualize Performance

By C. W. Starker

It is easier to see than to think. A correct decision can be more quickly reached if all of the necessary facts are arranged graphically in front of one's eyes, than if these same facts in the form of statements and figures must be grasped by the brain, fitted together and a conclusion drawn. Charts save mental labor in the managerial control of industry. From actual practice specimen charts are shown in this article for monthly output, productive labor, indirect expense, work-in-progress, defective parts, materials and tool repairs.

Mr. C. W. Starker *has been a member of the engineering staff of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., for the past fifteen years. He has originated improvements in the design and construction of both direct and alternating current motors for industrial and railway work, and has developed comprehensive systems of cost analysis for manufacturing purposes.*

GRAPHIC illustrations, curves, are always more impressive than a tabulation of figures, particularly to those who do not have the time to read long reports. Curves should be used to a greater extent in controlling manufacturing activities than is actually the case. Often a great deal of time is spent in securing data and compiling figures, but we fail to get an equivalent benefit from them, because there is nothing to answer the question in concise form, What is the lesson from all these data? Curves are the shortest and most striking means to this end. They are not the scientific, mathematical thing some of our older "practical" men at times consider them to be. In fact, according to the writer's experience, the story told in plain curves is readily grasped by shop foremen and clerks. If printed and hung up in the shop offices they become an incentive to efficiency and improving on past performances. Curves are useful for judging in advance probable expenses or requirements of material, for telling weak spots and predicting interruptions to production, fluctuations of costs, etc. A few interesting and novel examples from actual practice are given in the following:

A Monthly Production Chart

Figure 1 is a monthly chart of production. At the beginning of the month figures are established for the quantities required to be manufactured during the coming month by a given department. This is done, first, for the completed product, say automobiles or electric motors, and from this the number of parts—shafts, pistons, bearings, etc.—is readily figured and the load for each subdivision or shop section established. In setting up this figure, two factors are to be considered. The first is the productive capacity of the section according to equipment, working force and raw material available. This capacity is readily measured on the basis of the working force or tools, as may be decided upon in view of market and labor conditions. The second factor is determined by the sales requirements and the level of the stock carried in the storerooms.

For the case in hand, we assume that customers' orders on the books call for 6000 units sold on various deliveries, and that 2000 are carried in stock. This leaves a total of 4000 to be manufactured, not necessarily all during the coming month, but distributed over several months, according to the delivery dates promised. This figure, 4000, is entered in the "load diagram" at the top of the sheet as shown. Assuming further that 1200 units come due for delivery during the month and that 520 may be drawn from stock, there will remain 680 to be manufactured. This figure is entered in the production chart as shown, and gives the first line.

In addition to this the stock must be gradually replenished. To establish this figure it is necessary to consider the general outlook of business, the volume of sales that may be expected, and the deliveries already promised. On the other hand, shop capacity and possibilities of obtaining raw material and labor influence the length of deliveries, so that the question of how fast and to what extent stock should be built up is a somewhat involved problem requiring good judgment.

For the sake of example let us assume that 70 units are to be manufactured for stock during the coming month. This figure is taken low, much lower than the number of units taken out of the stock. Such conditions prevail at the present time, when prices of material are high, labor high and scarcely obtainable, and when customers' orders are coming in in great volume is not the proper time to pile up stocks. The storeroom stock should act as a balance wheel, in dull times built up and in rush periods drawn upon. With the above assumption we get, therefore, a total of 680 + 70 = 750 units to be manufactured for customers' orders plus stock. This figure is the "bogey" set for the month and entered in the curve as shown.

At the bottom of the sheet are given the calendar days and the shipping or working days, deducting Sundays and holidays, but counting half-day Saturday as a full day. After each working day the number of units shipped is entered in the sheet by a straight line over the date as shown. The aim is to keep the upper line from the start of the month, so that any slackness at the beginning and rush at the end is avoided. In the sample curve it will be noted, production proceeded fairly well during the first days, the upper line was not quite reached but the shop section kept well along the lower line. Around the eighteenth a falling off may be noticed, but apparently the cause was soon investigated and removed so that the loss was rapidly made up toward the close of the month.

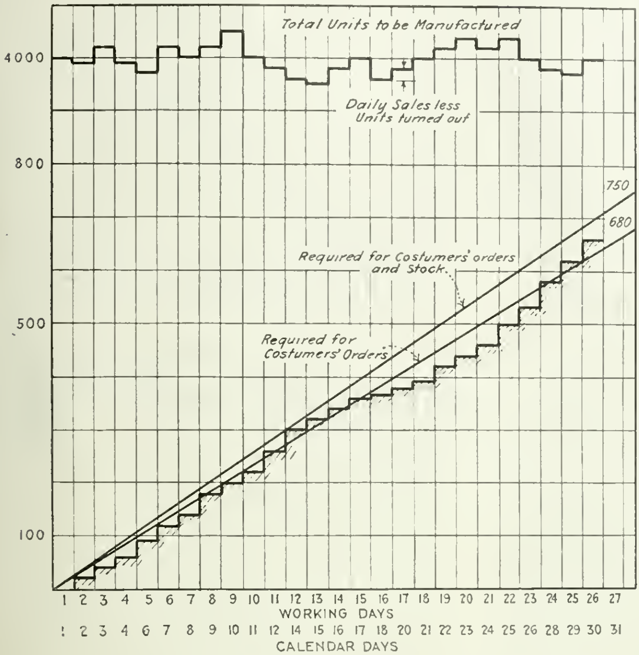

FIG. I. CHART OF PRODUCTION, MONTH OF MAY, 1917, DEPARTMENT NO. 34

This feature is the most valuable point of this curve system; if delays occur it is at once noticed by everybody as the curve is openly displayed. Naturally the foreman or production clerk will at once take steps to cure the trouble, repair the broken down machine tool, provide the missing material or whatever the trouble may be. It is quite apparent that this is ever so much better than complaints, explanations and reports afterward. If such a chart is kept and watched for all the different sections it means that in those sections or assembling departments which depend on others for the supply of parts or semi-finished material, there will not be a chronic lack of the one or the other item, but a continuous steady flow of the work. The interest in the chart is very much stimulated by paying a bonus for reaching the bogey, a higher percentage for the upper point, a lower one for at least reaching the customers' order mark. The system creates a healthy competition, with much good natured "kidding" and in general appeals to the men, always interested in a "game."

The load diagram at the top of Figure 1 is also brought up to date from day to day by entering the number of additional units sold on that day and deducting the number shipped. In the example in hand it will be noted there are quite marked fluctuations in the curve as the sales naturally do not come in at a uniform rate. At the end of the month, the total number of units still left to be manufactured was just about the same as at the beginning. As the stock had been drawn upon in the current month in excess of what was returned to stock, a greater output would, therefore, be required for next month. Showing this fact on the curve acts as an incentive to turn out more than ever next month.

ANOTHER DEMONSTRATION OF GRAPHIC METHODS

To demonstrate the usefulness of graphic methods along another line, I give the following example. An article may be manufactured with simple, inexpensive tools and at comparatively greater cost, or with tools involving a greater outlay but resulting in a cheaper product. In how far is the greater tool cost justified? According to what curve does tool cost go up and cost of product go down?

In Figure 2 is shown the cost of various kinds of dies, such as are used for making the slotted laminations of electric motors. The simplest form, the index die, punches one slot at a time and costs between $25 and $75. The compound die, in which all operations (slots, vent holes, center hole, key way) are performed in one operation may cost anywhere between $300 and $1,000, depending on the size or diameter of punching to be made and given on the curve in inches. The upper curves of Figure 2, show how the labor cost varies for a given diameter of punching, depending on what sort of die is used. By referring to the two curves then we see that, for example, with a total cost of, say $75, we get a labor cost of $20 per 100 pounds or per inch of build-up punchings, if the curve be plotted on that basis, while with, say, a $500 tool cost the labor cost may be $2. Knowing the quantities required annually and the approximate life of the die, we can from the two curves readily determine which type of die is most economical.

What has been said of dies, applies equally to other tools or equipment. Cases of this sort where a quick decision is wanted and the same question comes up again and again are very profitably handled by reference to graphic records.

PLOTTING OUTPUT ON A POUND BASIS

In Figure 3 on the curve is recorded the output of a finished product in pounds, the data being taken from actual practice. The product is such that measuring the output by the pound gives a fairly correct picture. With other articles of manufacture the records may more properly be based on finished pieces or units. However, the principle remains the same. At the end of every month, the total output of the month is entered on the chart, resulting in the curve•shown in dotted lines. The chart extends over a time period from January 1, 1915, to December 31, 1917, or three complete years. In addition to the monthly figures a summary of the last six months is made up and entered in a second curve, shown as a heavy line. For purposes of comparison the annual average output for the year preceding is always entered as a straight line during the year following.

Taken as a whole it is interesting to note, and typical for many industries, how great an increase in production is shown by this curve (which, as stated, is taken from actual manufacturing data) for the year 1915 to

1917. At the beginning of 1915 there is a noticeable increase from the previous high level until April, inclusive, when the lowest point is reached. From then on there is a steady rise in output up to the present high level, except perhaps a little slacking off with the curve running practically horizontal in 1916. The average for 1916 it will be noted was far in excess of that of 1914, with 1917 promising to be still higher.

Those of the works force, who see a curve such as this every day, soon know that a dropping curve is bad, a horizontal curve is fair, and a rising curve the thing to be aimed at. The monthly figures give a rather unsteady zig-zag line, showing that there was not as uniform a flow of work as desirable. There is, for instance, in April and May, 1916, a bad drop, which may have been due to a breakdown of equipment, shortage of help or difficulties in obtaining raw materials or perhaps a change in personnel. Those in direct charge become alert and look ahead so as to avoid a dropping of the curve, which they know is being carefully and critically observed by those "higher up in the plant."

Curve of Productive Labor

However, the turning out of great quantities is not the prime object in production management. At least an equally important question is whether or not the manufactured article is produced economically, at a low cost that will insure profit. Factory cost is composed of cost of labor, cost of material and overhead expense. All these items can be treated graphically to good advantage.

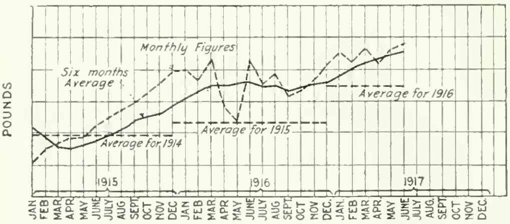

FIG. 3. OUTPUT IN POUNDS FINISHED PRODUCT

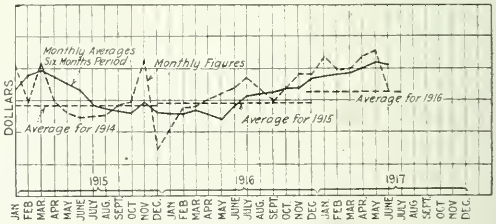

FIG. 4. PRODUCTIVE LABOR PER POUND OUTPUT

In Figure 4 is a curve of productive labor. By this is meant the amounts spent directly in making the article, i. e., the wages of the machine operator plus the wages of helpers and expense in bringing material directly up to the machine, carrying away scrap, etc., but not including wages or salaries of foremen, inspectors, and others which is part of the overhead expense. The curve for productive labor may be based either on the pound output or on the dollar net value of product, depending upon the character of the product. In fact within the same works one method or the other may be preferable for some manufacturing sections. As a general rule a composite product is better measured on a dollar basis, a simple, uniform product, for instance punchings of uniform character, is more readily measured by the pound. In either case the values are plotted at the end of each month giving the total amount in dollars spent in that month as wages for directly productive labor. The curve appears rather irregular and a better idea of the general trend of labor cost is gained by the curve of six-months averages, shown in heavy lines. This curve is taken from the same shop section and for the same time period as the curve in Figure 3.

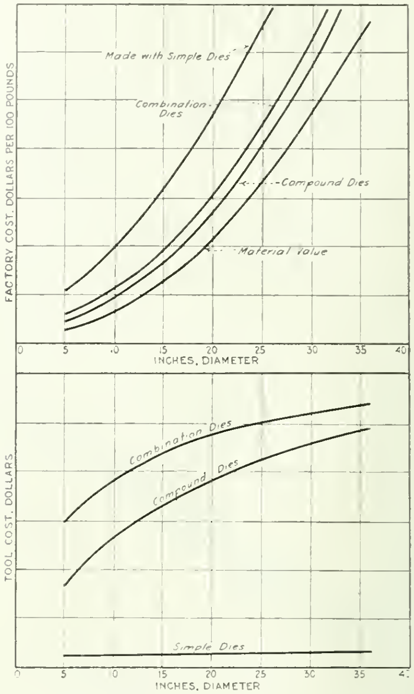

FIG. 2. CHART SHOWING COST OF VARIOUS KINDS OF DIES

It is interesting to compare the two, noting the influence of quantity produced on labor cost. It will be seen that the labor cost per pound drops with rising production, but not nearly in proportion. In fact, it may be noted how the hiring of additional men, not fully familiar with the work, tends to raise the curve. From May to July there is a marked increase in labor cost and from then on a steady and substantial rise due largely to higher wages paid at that time and since. However, a more complete analysis of the underlying

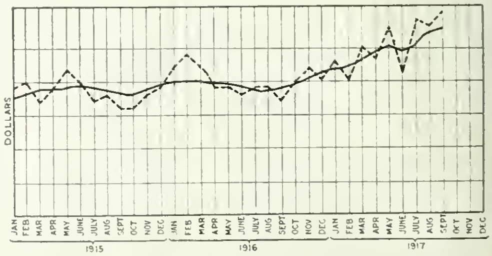

FIG. 5. INDIRECT FACTORY EXPENSE IN DOLLARS PER 1 DOLLAR OF NET PRODUCTION

conditions would be required really to draw conclusions from the curve, as naturally the higher labor cost

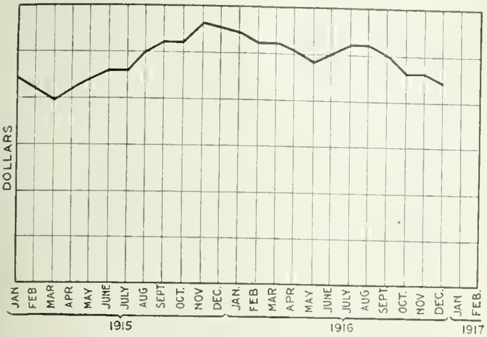

FIG. 6. WORK IN PROGRESS OF MANUFACTURE PER DOLLAR NET PRODUCTION

in making a certain article may be and, in fact, was, partly offset by improved methods, better though more expensive tool equipment, etc. But for the purpose of this article it is intended to call attention to a method rather than analyze manufacturing conditions.

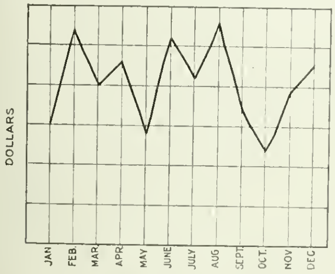

FIG. 7. DEFECTIVE PARTS RECORD

CURVE OF OVERHEAD EXPENSE

Control of the second item entering into the cost of product, overhead expense, is taken care of graphically in a manner quite similar to labor cost. Figure 5 shows

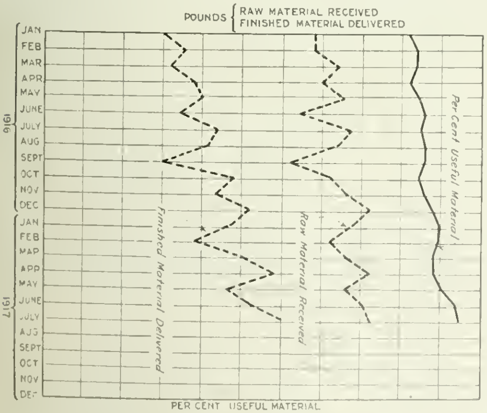

FIG. 8. ECONOMIC APPLICATION OF RAW MATERIAL

this curve for overhead or indirect factory expense, recorded as a total in dollars for every month, and based on the dollar value of net production. Overhead burden is usually divided into two or more classes, expenses of a general nature shared by all works divisions and expenses peculiar to the individual shop section, or, expressed in another way, those controlled by the works manager and those for which the individual superintendent or foreman can be held responsible. Under the first class come general administrative expenses, works transportation facilities, insurance, schools of apprentices, etc. Under the second class are repairs or betterments in the individual section, wages and salaries of inspectors, foremen, etc. In a curve to be posted in the individual department and intended to stimulate efficient control of expenses in each department, we are only concerned with the latter class. Corresponding curves covering the broader expenses are maintained in the works management office.

MAXIMUM PRODUCTION AND MINIMUM WORK-IN-PROGRESS

Tieing-up a large amount of money in semi-finished material, called "work in progress of manufacture" or for short "work-in-progress," is an uneconomical and inefficient procedure and takes valuable floor space. The object must be to take care of a maximum output with a minimum amount of work-in-progress.

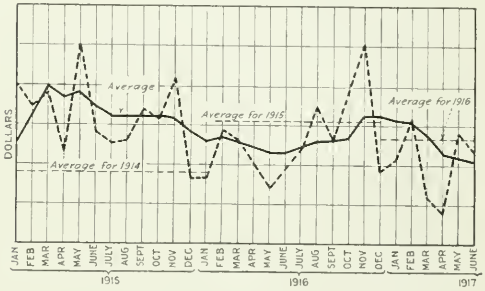

FIG. 9. TOOL REPAIR IN DOLLARS PER POUND OF OUTPUT

Figure 6 shows such a curve. As such work we count all parts carried in the various sectional storerooms or on the manufacturing floor of the department and do not include such parts as are carried by the general stores division. Under the latter heading come all raw materials such as axle steel for shafts, sheet steel, copper, rough castings, etc., and such detailed parts as are turned over to the general stores in finished or semi-finished condition, for instance, certain forgings, bearings and similar parts carried principally with a view to supplying repair parts to customers directly from general store. Practically all other parts or materials are carried by the manufacturing sections and come under work in progress.

The values used in the curve for this material are the same as used in billing to general stores or for inventory purposes, that is, calculated by the respective section of the works cost department according to the prices and instructions in force at the time for raw material values, overhead expenses, etc. In plotting these values the curve is best based on the net value of the total production, understanding by net value the difference between value of goods received by the department and value of goods shipped out of the department. It is, of course, the aim to reduce continuously the relative amount of money tied up in work-in-progress, that is, to reduce the ratio between output and material on hand. This part is best brought home to all by a note on the curve sheets to the effect that rising curves are bad, horizontal fair and drooping curves good.

Checks On Workmanship and Materials

Figures 7 and 8 illustrate the graphical checks on workmanship and the efficient use of raw materials, and will, from the foregoing be understood without much comment. The curve for defective parts may be varied according to local conditions and may be applied to defects discovered on inspection or on the test floor. Segregation may be made in the curve to causes of defect or individual men. However, this is likely to destroy the clearness and thereby effectiveness of the method and involve in many instances too much clerical work. A good thing may be overdone, and in the writer's experience it is quite sufficient to analyze from time to time the reasons, when the curve indicates an undesirable condition. Good success has been made with similar graphic records for defects coming up on apparatus in service, and defects due to engineering errors. In these cases the curves are best plotted on a dollar basis, rather than number of units shipped per month, and plotted without reference to the number of units that may be of service. In all these cases the general method of graphic records is similar and the result the same. A continued effort on the part of all concerned is made to reduce undesirable losses and attain improvements over the past.

In regard to economical use of material, this point is best illustrated by taking the example of a punch shop manufacturing various sizes of punchings, mostly from the same grade and gage of sheet steel, as in punchings for electrical apparatus. If large circular punchings are made from square sheets there will be corners and centers left over. These should be used up for making smaller punchings for the sake of economy in material, which is called for particularly at the present time when electrical sheet steel costs three or four times its normal price. On the other hand, small punchings can be made quicker from strip, so called long iron, than from odd pieces such as these corners left from large circular punchings. With forced production especially, there is a temptation of leaving such corners unused, to be sold at scrap value involving a loss of around six cents a pound at the present day. With a punch shop turning out, perhaps, 2,000,000 pounds of finished punchings every month the scrap annual amounts to a very large sum and close control, therefore, is a paying proposition.

Figure 8 gives an example of the arrangement of a curve for graphic control, recording raw material received for each month, finished material turned out and the ratio between the two. It may be remarked that in a punch shop manufacturing electric motor punchings hardly more than 60 per cent. of the original material leaves the section as good punchings, even, if all corners as well as centers are used up, so far as it is economical to do so, in view of the higher labor rate to be paid for making punchings from short ends instead of long iron. A stimulus in this direction is, therefore, very desirable for improving the results of shop output.

Expenses for Tool Repair

Another example of graphic control may be taken from punch-shop experience. Figure 9 shows expenses for tool repair in relation to output. The overhead expense in a punch shop is always large, principally on account of expensive renewal of dies. After making on an average 10,000 to 15,000 pieces from a die, the cutting edge becomes dulled sufficiently to cause burrs on the punchings. This means regrinding of the die and involves taking out the die, i. e., set-up expense and delay to production. After 50 or 75 regrindings the die is worn down and must be renewed. Its total life, therefore, is not long in standard production on a large scale. Graphic control has led to very interesting studies in regard to how often it is really necessary and good practice to regrind, how much burr or change in size can be permitted. Construction of dies and materials used has been studied and greatly improved. Better hardening methods and more favorable shapes of punchings have been devised, since the importance of die repair cost has been brought home to all concerned by graphic presentation.

This is only an example. How much money is wasted in your own plant in careless use of saws, files, rawhide mallets and what not? Could not much of the expense of replacing patterns and core boxes for the foundry, milling cutters and drills, jigs and gages in the machine shop be saved by a simple graphic method of control?

Cause of Industrial Fatigue

By C. B. Lord

General Superintendent, Wagner Electric and Manufacturing Company

THE man who first said that "our greatest troubles are those that never happen" intended an epigrammatic thrust at those who worry over trifles. But in the light of our present knowledge his remark was literally true. Our sufferings are almost entirely mental, whether they be occasioned by physical ailment, bereavement or misfortune, and are generally anticipatory.

The most acute mental suffering is caused by uncertainty. No trouble, the actual facts and limits of which are known, ever equals the one our imagination conjures up, and the higher the mentality the greater the trouble. This is probably the survival of the cave days of the race, when the reason for darkness was the displeasure of the gods, and night was full of imminent, real dangers. Millions of years of advancement have not eradicated the primal emotions from either sex, and fear, next to hunger, is the first sense an infant experiences.

Mental Fatigue

The modern name of worry is mental fatigue. I can think of no other factor more dangerous to health, happiness and the rights of others than this. We guard against epidemics, poisons, bad ventilation and other things more or less dangerous. Some time we will educate against worry, which has wrecked more lives, caused more misery and crime, and filled more insane asylums than any other cause. At present we smile and consider it one of the psychologists' white mice—an interesting experiment, but hardly out of the laboratory stage. It was worry, not curiosity that killed the cat, and it had nine lives.

Mental fatigue is closely allied to physical fatigue. The latter does not always produce mental fatigue—often quite the reverse—but mental fatigue invariably produces physical fatigue.

Cause and Effect of Fatigue

Until comparatively recent times it was not really known what the cause or effects of fatigue really are. Now we know, or are told, that it is a toxin, which when accumulated in larger quantities than can be taken care of by the system acts as a rapid poison. We are also told that our body is made up of numberless cells, each cell alive, independent, and we might say with a digestive system of its own.

Just as with a body as a whole, these cells must be fed; they must assimilate what they require and must get rid of what they have used. Their source of supply is the blood—their ordinary sources of discharge are through the blood, pores of the skin, kidneys and lungs. Also, like the body, they are capable of assimilating only a certain amount of material in a given time, just as our capacity for eating is limited. If the cells are called upon for additional work, they respond readily so far as input is concerned, but our system begins to find trouble with the waste products. If this over-exertion is contintued long enough, a person becomes as truly poisoned as though he had swallowed a poisonous substance: for the blood is "a pathway for poisons as well as a channel for food." If fatigue lasts long enough death will result. The animal that drops dead while being hunted has not done so because of heart failure or fright, but because its system has become impregnated with poison, and the carcass decays much more rapidly than one that was shot.

It has been demonstrated that fatigue poison does not confine itself to the tissues in which it arises, that is, if we lift a weight continually, until our arm is tired our whole body becomes tired. This is caused by the blood circulating the toxin to all parts.

Law of Recuperation

However, all this applies only to excessive fatigue. The body readily and rapidly disposes of and renews the waste products due to ordinary work, by the simple process of rest. It is necessary, roughly speaking, to rest twice as long as we work. It is upon this statement that many philanthropic reformers base their claim for an eight-hour day—twice as many hours of rest as work.

These people, however, remind me very much of a story as to how the birds learned to build their nests, which the writer must have meant as an allegory on modern conditions. It seems that all the birds were gathered together to be shown how to build their nests; first, the instructor scooped out a hollow place in the sand—some of the birds, owing to their superior intelligence, said, "We understand perfectly," and left to start rival schools. Some stayed a little longer until the sticks were laid, and they in turn said, "We get you," and left. So we find that the eight-hour day advocates left the meeting early. They did not wait to find out that the above law, though the closest we can come to a standard, has many variations. First, it refers to over-exertion; second, to hours, minutes and seconds—not days; third, mental fatigue and surroundings enter freely into its operation.

Furthermore, the same law says if I work myself to exhaustion in four hours it will require eight for rest; if I work at the same rate for two hours it is not necessary to rest four hours, but only two; if I work at the same rate for one hour, thirty minutes is sufficient. This, however, means continuous, exhaustive work, and in no trade that I know of does a man work himself to exhaustion in four hours. It was by applying the above rules that Taylor vindicated his theory by increasing the man-day average for loading pig iron from 11 to 42 tons per day. It is a law that recuperation is slower the longer the time between rest periods.

Factors That Lessen Fatigue

Discipline, concerted action and stimulation also tend to lessen fatigue—the first two permanently, the latter temporarily. Trained bodies of troops will march farther in a day with less fatigue than an undisciplined mob. This may be partly due to the fact that the length of step conducive to the least fatigue has been ascertained, but it is also due in part to the mental attitude of the man toward marching, and the mental support of his companions. An instance of stimulation curing fatigue is that this same body of troops may march all day and be tired, but the moment the band plays a march they straighten out and forget for a considerable period their physical fatigue.

Another example of mental fatigue may be found in the wrong-doer. It is usually much easier for the pursuer to overtake the pursued than *vice versa;* the reason is that the pursued has the fear that the other one may overtake him, and the pursuer's feeling is a determination to do so. In the case of the pursued, his feeling detracts from his strength. The expression "fear lent wings to his feet" is not a truism as regards the speed attained, but rather emphasizes the additional physical effort necessary.

Delayed Decision

One of the most prolific causes of mental fatigue in business is delayed decision, both as regards things one must do oneself, and matters referred to a superior where a decision is not given. This works both ways. It leaves the one awaiting the decision with a mental burden not rightfully his to carry, until such time as his superior may see fit to remove it. To the superior it is a constantly recurring thought and cannot help but produce mental fatigue, because mentally, as otherwise, a change is restful. In my estimation, no man can approach the maximum of efficiency who does not make decisions instantly, even though it be necessary to reverse some of them later. Any mental load carried over is as detrimental to mental efficiency as a pack on his back would be to the physical efficiency of a man carrying pig iron.

Worry is the visible sign of mental fatigue, and a symptom of lack of decision and executive ability. No man who worries can be wholly successful: his worry is usually caused by the magnitude of his responsibilities, in other words, his job is too big for him. Put in some lesser position he would not worry, and would therefore be efficient.

Efficiency Lies in Mental Attitude

I am coming more and more to the conclusion that the efficiency of man lies as much in his mental attitude as in his manual skill. Since writing the above I found this in Scott, "Success or failure in business is caused more by mental attitude than by mental capacity." I do not contend that being contented and happy makes a man skillful, it does not. But if a man has a certain skill, being contented enhances his productive output and lessens his liability to mistakes, hence increases his efficiency. I also find that contentment is not induced by letting a man alone, as much as by laying down fair, strict rules for him to follow. When he becomes habituated to these rules he becomes contented, provided always that the rules are just, equitable, and for his ultimate good.

Among women mental fatigue is most prevalent, taking into consideration only those encountered in commercial business. We find that they have many small worries a man is not subject to, and the majority of them are those a man would not think of

Under New Management—Harmonizing

Some Industrial Managers Are Appealing to Men's Willingness to Work Instead of Commanding Obedience

By Charles M. Horton

This article is an appeal for an understanding of why workmen fail to do what they are arbitrarily ordered to do, and a teaching of a better course of action on the part of those who are industrially strong—the employers.

Mr. Charles M. Horton, *member of The American Society of Mechanical Engineers, was educated in public schools of New York City and at the University of New Mexico. He served a drafting room apprenticeship and had twelve years' experience in designing special machinery, part of that time with the Westinghouse Machine Co. As an avocation he has pursued literary work, writing for both fiction and technical publications.*

INDUSTRY today is a clash. Indeed, it always was a clash. Clash is the opposite of harmony. Harmony is sweet sounds. Certainly there are no sweet sounds in industry. Rather, the undercurrent—like the overcurrent—of chattering tools, meshing gears, shrieking belts is a rumble. The thing requires adjustment. It is just a little worn out. Men of industry, upper and under, are a bit overstrained. Each has been worked out of pitch, one with the other. The tuning fork has become lost—if ever it was used. President and general manager, superintendent and foremen all have been drawn to the snapping point, even as the workmen at the bench have become "tensed," as it were, by the same willful force—competition.

All life is a fight and industry always was the chief battleground. As a battleground industry has this difference over all other battlegrounds, however, it lacks a common aim. Men in today's war have a common interest—a common objective—among the Allies it is Berlin. Hence there is harmony in their ranks. Not so on the battlefield of industry. Men engaged in a life-struggle here are engaged in a life-struggle each for himself, each for his own. Instead of a common objective, unselfish, uplifting, with everyone pulling or pushing in the same direction, we have the spectacle of a great army, each member of which has a coal in the common fire and each is endeavoring selfishly to keep his own coal alive and only his own. It is the negative of concentrated action; it makes for strain, discord, lack of harmony.

What do I mean by harmonizing industry? I hope, you, Mr. Industrial Manager, will understand me. Your first step is to protect and help the weak in your organization, to train the unskilled and partly skilled, to encourage and stimulate the laggards and easy going, to create the "spirit of the organization" and to upbuild coöperation. And, as you go over the top in this big effort, I wish you the best of luck and lots of it.

One Electrician's Handicap

There was once a workman. He was a man of family, a wife and four children. His wife was an invalid. In the mornings, after he arose, he would build the fire, run out for the rolls and milk, return to the flat, dress the children and place their breakfast before them. Then he would eat his own breakfast. He would do this always with an alarm clock at his elbow. Ever and anon, he would glance at this most friendless of mechanical devices. Frequently, as he ate, his wife called from her bedroom to tell of petty duties yet to be performed—duties which she herself was unable to undertake. He knew her condition and would gladly do them. Sometimes he would put the wash to soak; at other times beat the rugs in the cellar; again, wash out a few needed pieces, leaving the others until his return home in the evening. And always he would watch the tiny clock.

Suddenly, in a mild panic, his time gone, he would grab hat and coat and dash for the door. The youngest of his children and even the next youngest would call him back poutingly for a farewell kiss. He must return and kiss the children. Then he would speed out the door. He lived up three flights and would descend the stairs two and three at a time.

He was an electrician in one of the city plants. The concern was located some twenty blocks from his home. He tried to be saving. Always he would walk to his work. Passing clock after clock in store windows as he hurried along, he would see that time was pressing. So he would run. He would run the whole distance to his work. Frequently he would arrive at the door in time, just in time, to see the watchman close it against him. He could not enter. Automatically he was shut out, by a rule of the organization, until noon and lost a half-a-day's pay.

Effect of Personal Competition

That is a true story. I know the man. He is embittered, of course, and realizes that somewhere there is injustice. Yet he is not vengeful, not vindictive, not clamorous for his "rights." Merely, he believes something is wrong. He has fine gray eyes, a large, generous, wholesome mouth, and a very intelligent countenance. He talks well, because he was reared well. He came to the city from the country because he thought he could better himself—his condition. Competition was strong, and he found himself a gentleman among a pushing, grasping, dog-eat-dog throng, no part of which he was or ever could be. In the struggle which followed for a living, the world lost one of its finest souls. Competition helped to kill off all that was good and true, noble and honorable in the man—though one would not know it from his speech or actions. It was lost out of him, nevertheless. It revealed itself in the lack-lustre, staring gaze of his otherwise fine eyes. He had gone down under a fierce grasping competition for money.

That man was out of harmony with his conditions. Let me put it the other way round. The conditions were out of harmony with the man. We need men of his calibre in this workaday world. He and his kind should be saved. Yet in the present system of things in industry, if there be no readjustment we shall become a race of fierce, grasping people. This, because the other kind cannot and does not survive. Competition is too great for them, too riotous, too fraught with the thing that kills. That which is fine in mankind should be preserved for mankind. Men in industry—industrial captains, leaders, executives, managers—have it within their power, more so than any other group of folk—to save mankind for itself. They have it because industry is the great life's battlefield. Through harmony—by harmonizing the game as a whole—the better side of humanity can be saved out of the dross, the material and the sensuous.

THE LESSON OF THE OXEN

Underneath my window a yoke of oxen is lumbering along the road, drawing a sled piled high with cord wood. They are perfectly matched as to size and color, the latter a deep, rich, red brown. Though well matched in color and form, however, they are not mated as to pulling power. At least, one reveals greater willingness than the other to draw the load. As a result there is trouble. The load moves forward in fits and starts making poor headway, first one then the other of the oxen is backward in the yoke. The man—the driver—uses his lash freely. But goads hold no terrors for oxen. Certainly the unwilling member of the yoke reveals nothing of spirit under the whip. The narrow roadway is blocked; another team comes along and pauses; then another. Finally—like a jitney and certainly without apparent reason—the unwilling member of the yoke sets forward. The oxen now are pulling in unison—the load goes on. Going on it opens the way for the next team behind, and then for the third. Presently the roadway beneath my window is clear and free of all traffic.

That is industry. Pulling in unison, capital and labor will go on clearing the road of progress. Balking, either the one or the other, the way will be blocked and continue to be blocked until the refractory member of the yoke decides to pull with its mate. For mates they are—capital and labor—however the situation may appear otherwise. There need be no revolt, no revolution, nor plying the lash one against the other. Goads hold no terrors for oxen once set upon balking. It is a matter simply of education. It is a matter simply of recognition, one the rights of the other.

Take the yoke of oxen once more. Which, think you, is the more powerful?—the driver with the goad, or the yoke of oxen? I will tell you. As it stands, the man with the goad is the more powerful. But that is due to the brute intelligence of the oxen. We all know that underneath their dumb willingness to serve they have the strength to crush the driver.

Industry is like that. It is a matter of education. Recognizing the rights of workmen capital can become effective. Today it is banging its weak head against a wall becoming ever more solid and resisting, and it is doing it through sheer blind ignorance of a few well known truths. One of these truths is that men—life—are all, everything. They are not a part, with money the ALL.

ONE OF EMERSON'S STORIES

I am minded to set down a story embodied in one of Emerson's Essays. The essay itself was written over half-a-century ago. But, then, Emerson was a seer, and the thing was written for, and is applicable to, all time. The particular story I have in mind is possessed of the power to make men think, as are all of the writings of Emerson, however one may or may not agree with the voice of the man. Here it is:

> But when this great tendency comes to practical encounters [meaning this game of life and living] and is challenged by young men, to whom it is no abstraction, but a fact of hunger, distress, and exclusion from opportunities, it must needs seem injurious. The youth, of course, is an innovator by the fact of his birth. There he stands, newly born on the planet, a universal beggar, with all the reason of things, one would say, on his side. In his first consideration how to feed, clothe, and warm himself, he is met by warnings on every hand, that this thing and that thing have owners, and he must go elsewhere. Then he says: If I am born into the earth, where is my part? Have the goodness, gentlemen of this world, to show me my wood-lot, where I may fell my wood, my field where to plant my corn, my pleasant ground where to build my cabin.
>
> "Touch any wood, or field, or house-lot, on your peril," cry all the gentlemen of this world; "but you may come and work in ours, for us, and we will give you a piece of bread."
>
> "And what is this peril?"
>
> "Knives and muskets, if we meet you in the act; imprisonment, if we find you afterward."
>
> "And by what authority, kind gentlemen?"
>
> "By our law."
>
> "And your law—is it just?"
>
> "As just for you as it was for us. We wrought for others under this law, and got our land so."
>
> "I repeat the question, Is your law just "
>
> "Not quite just, but necessary. Moreover, it is juster now than it was when we were born: we have made it milder and more equal."
>
> "I will none of your laws, returns the youth; it encumbers me. I cannot understand, or so much as spare time to read that needless library of your laws. Nature has sufficiently provided me with rewards and sharp penalties, to bind me not to transgress. Like the Persian noble of old, I ask "that I may neither command nor obey." I do not wish to enter into your complex social system. I shall serve those whom I can, and they who can shall serve me. I shall seek those whom I love, and shun those whom I love not, and what more can all your laws render me?"

THE AUTOCRACY OF INDUSTRY

There you have it. It is as old as it is new, and it is as new as it is old. And in offering it, and self, it might be well for me to state that I am a follower of no "ism" except Americanism. But little justification exists from one's pride of birth. Yet I am as proud as Lucifer of my ancestors, who first broke ground in this country for an ideal, and who later helped to establish the first democracy in the world. I do not want to see this democracy crumble. The form of government is right—as nearly right as any human device ever can be right—and yet industry, through its material grasping, its ignorance of facts, is undermining this form of government, is setting up a concealed autocracy as mighty as that autocracy which as a nation we have linked ourselves together with other nations to overthrow. We shall overthrow it. God grant that. But also let us not fail to look within.

We mean no harm. Industry means no harm. Men in power in the industrial world do not know—that is all. Methods in practice today are but habits grown out of long usage. It is like a certain man-neighbor of mine, who uses both knife and fork to assemble food into his gullet. Using the knife has become a habit with him. He means no harm. Yet some day he will cut his face—his mouth, say—and then he'll wake up. He means all right. Most men do. Industrial captains are no exception, either. They mean all right. But in the ecstatic chase and pursuit of dividends these men have lost sight of first principles—have become blind, as has been said somewhere, from their own dust—and the blindness has grown to a vicious habit. This habit has thrown them out of harmony with mankind, like my neighbor-friend who uses his knife, and the near outlook, it must be admitted, is bad.

SPIRIT OF HARMONY—CO-OPERATION

In the quotation from Emerson, above set forth, one sentence stands out prominently valuable for the purposes of this article. It is the remark of the Persian noble out of the mouth of the youth, "that I may neither command nor obey." This is the cornerstone upon which the house of industrial harmony may safely and effectively be reared. The practice of this will turn the trick. Close not the doors upon workmen a minute or two minutes late. Neither discharge the man whose attitude or work brings unfavorable report from his boss. Nor yet put the screws to him who shows inclination to soldier or play on the job. We all know these kinds of men—in the abstract. Concretely we know nothing about them. We lack the patience to learn. Our habit of mind is fixed in this respect. They are judged as incompetent or undesirables—quick as the snap of your finger—and arrangements are made to get other men to fill their places, which is a foolish, blind, willful error. Individual units of industry should be regarded in the light of a big family.

All big families have their weaklings, their incompetents, their undesirables, viewed socially. Yet no head of these big families believes it encumbent upon him to throw the incompetent or the undesirable or the weakling out of the fold. Rather, the head pays more attention to the development of this inefficient one, to the end, and in the hope, that the cause may be found and a remedy instituted. So with industry. The strong and efficient can well care for themselves. The weaklings need supervision of a character and a kindliness the result of which will make for harmony.

THE INDUSTRIALLY STRONG MUST PROTECT THE WEAK

Labor organizations protect their weak. That is why labor organizations exist. The strong and efficient are worth their four and five dollars a day. The weak get it—not because they are worth it as compared with their strong brothers, but because the weak must eat and sleep, as must the strong, and therefore must have it.

Many a workman is weak or incompetent through no particular fault of his own—efficiency schools to the contrary notwithstanding. If he lacks the initiative or the willingness to prepare himself for a better industrial fight, that is as much a weakness as a troublesome lung, or a club foot, or faulty vision. Because this weakness is not so openly apparent, however, men in power are inclined to lay the heavy hand of cynical blame upon the unfortunate, and cast him out. And out he goes. And like a pebble tossed into the still waters of a pond, which sets up a gradually increasing circle that goes on and on to the distant shores, so this man, sets up disturbing ripples against the system which cast him out, the returns from which are bound to come, and in thousand fold, to the man or institution that "outcast" him.

The strong should protect and help the weak, not prey upon them. Industry, in harmony with mankind, will practice this care. Thus one source of great unrest will be crushed out of existence with kindness.

Power Economy An Essential Factor in Winning the War

By W. Rockwood Conover

Power is one of the chief items of factory expense. That industry may do its full duty in these days of mounting production power must be economically generated and distributed. Mr. Conover *takes up many points in the economy of power production from the double viewpoint of the power station and the shop.*

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CONSERVATION of fuel has become an urgent world-wide necessity. Never before in the history of industry has there existed such universal need to reduce coal consumption and effect economy in the production of power. The country is already facing a shortage amounting to millions of tons. The demands for fuel for government operation, for railroads and shipping, for munition and war material factories, and for industrial operations in general are rapidly increasing. Under the new period of reconstruction after the war the demand for fuel to operate the industries which must accomplish the rehabilitation of the world will still be great. Now, more than ever before, it becomes imperative for the manufacturer to make exhaustive investigations and inaugurate changes that will result in cutting down his yearly supply of fuel. Construction of new power houses and extensions must receive special consideration. Modern types of generating units, boiler house equipment and latest designs of installation and station apparatus must be substituted for the old; more scientific methods of operation must be established, and greater care exercised in the selection of fuels.

Power constitutes one of the chief items of expense in nearly every plant. The cost of generating power in large industries is usually prorated either against individual departments or shops, or against specific classes of apparatus. In factories where power is purchased from municipal or private corporations it is necessary to establish a system of allocation which insures the equitable distribution of the expenditure against the proper productive accounts and classes of product.

NEED OF SKILLED SUPERVISION

The economic generation of power and its distribution to the shops require skilled supervision. More consideration is given to this part of manufacturing in large industries than in the small factory where it is frequently an item of outside purchase and contract, and is looked upon with more or less indifference as one of the unavoidable expenditures of the business. Under either condition the subject demands the intelligent and active interest of factory department heads in controlling the consumption of current and preventing undue waste.

In order to secure practical economies in the manufacture and distribution of power, careful consideration must first be given to the principal types of station equipment, the initial or investment cost in real estate and station apparatus, and the cost of installation. In the construction and equipment of the modern generating station a high degree of scientific knowledge and skill on the part of the designing engineer is essential. The economic production of power depends largely upon the type and character of the installation which he provides. The arrangement and installation of the boiler house, including boilers and appliances, coal crushing and conveying apparatus, pumps and condensers; and in the engine room the installation of generating units, turbines, rotaries, transformers, switchboards, and other distributing apparatus, must all receive careful consideration.

In planning the erection of new power houses it is essential that the manufacturing conditions in the various shop departments be studied, and the amount of horse-power energy necessary to be supplied each shop carefully estimated, in order that proper generating capacity may be provided in the power station. Consideration should be given to future requirements emanating from increased manufacturing facilities, such as expansion of departments, erection of new buildings, additional machine-tool equipment, etc. The power-house area should provide for the installation of additional units within the reasonable limits of the natural growth. of the business and resultant increase of loads required to be carried.

In the distribution of electrical energy it is essential that the transformers and instrument equipment be of improved types, the correct sizes of transmission conductors be used, and all conditions affecting loss in distribution, such as distances to the various shops to which current is supplied, impedence, etc., be carefully investigated and computed.

In the smaller sized stations, supplying energy to the small and medium sized industries, it is relatively as important to install the modern types of generating units and auxiliaries and modern types of boilers and boiler house appliances as in the larger station, in order to secure the high degree of efficiency desired and a proper basis of cost to be distributed against the manufacturing departments or charged to the outside consumer.

POWER-PLANT OPERATION

To secure a high degree of efficiency in operation and the largest measure of economy in production cost it is essential to have men with extended experience to fill not only the positions of supervision but also all the other functions of power-house labor. This phase of power production is relatively as important as the investment cost of buildings and installation, or the design of station and type of generating units and boiler house apparatus and appliances. The proper care of generating sets, auxiliaries, and all engine room equipment, care of boilers, pumps and condensers, stoking of fires, cleaning of flues, grates and chimneys, quality of feed water, etc., are all essentials of good operation. To operate with high efficiency the boiler room should be equipped with the best types of modern appliances, such as flow meters, draft gages, feed water regulators, mechanical soot blowers, etc. With a properly designed furnace and boiler of 600 h.p. capacity, when operating from normal rating to 200 per cent. of rating, the flue gases should range in temperature, under ideal conditions, from 450 to 500 degrees fahrenheit, and the CO_2 average closely 13½ per cent. Mechanical soot blowers, when applied to boilers of the 600 h.p. type will secure a reduction in flue temperatures, aid combustion, and effect a consequent valuable saving in consumption of coal and maintenance of stokers. Tight boiler settings, tight baffles, etc., are also necessary to a high degree of combustion.

Boiler-room practice at the present time tends toward higher ratings and pressures. It is essential, therefore, to insure constant and safe operation that the feed water should be of the best, and careful attention be given to condensate and returns, keeping the percentage of make-up water down to the minimum. The latter can be specially treated or purified before entering the feed-water system.

Combustibles in the ash are important. The boiler operator should take special care in burning down fires previous to cleaning, to insure the smallest percentage of combustibles remaining at the time of removal.

BOILER AND ENGINE ROOM LABOR

Boiler rooms in the past have largely been operated by an inferior class of labor. Manufacturers in general have devoted their energies to the production of salable product and to manufacturing costs, and have given little attention to the production and cost of power. To secure the highest efficiency in operation it is essential in the modern station to employ a skilled and intelligent class of labor. It is obviously the sole function of a generating station to produce the greatest amount of mechanical energy from the latent energy in the coal at an economic cost per h.p. To do this we must have experienced and skilled men in the boiler room. Constant attention must be given to flues and grates, to the proper regulation of drafts, and to maintaining clean bright fires throughout the hours in which the maximum load of power is required by the shop. Unless grates and flues are kept in clean condition, drafts regulated, and fires properly stoked, the combustion of fuel will be incomplete and the chimney loss excessive. In modern stations it is customary to employ a combustion engineer equipped with a full knowledge of the theoretical and practical elements of boiler-room operation.

In the engine room skilled supervision and experienced labor are also manifestly essential in securing economy in operation. It is the function of the engineer to direct the work of operating the generators, turbines, and auxiliary station apparatus efficiently, and to control and distribute energy to the various shops in the voltages and quantities required. The subject of overloads requires the engineer's constant attention, to save unnecessary consumption of fuel and waste of power. It is evident that the loss in distribution of electrical current and amount of load to be carried, however, will depend in no small degree on the construction of the transmission lines, their length, capacity, etc., and this emphasizes the importance of accuracy in this feature of construction work. If the load carried can be kept within five per cent. of actual voltage required in the shop departments, a reasonable point of economy can be said to have been reached. All of the generating equipment requires skilled attention and systematic inspection and care. Losses through distribution, friction and other causes must be investigated and effort made to reduce these factors of waste to a minimum. Proper lubrication through a return oiling system, consisting of tanks, pumps, filters, etc., is essential to provide a continuous flow of oil to the feed cups and a uniform and adequate lubrication of the cylinders, bearings, and working parts of the engines or turbines.

The foremen of the manufacturing departments can also render valuable aid in effecting economy in consumption and conserving energy distributed to the various buildings. It is necessary that the head of each department endeavor in every way possible to economize in the power delivered to his shop. The average foreman does not fully appreciate this fact. To him it appears like an unseen source of energy, and consequently receives less attention than the more obvious expenses of his department. A most common illustration of this is the leaving of field switches on motors closed when current is not required. When shop motors are shut down for any appreciable length of time the field switches should always be opened to take the current off the fields. This will not only prevent unnecessary burnouts, but will also save power.

Fuel Consumption and Supply

The subject of fuel requires careful investigation. Every unit of power and every unit of heat represents consumption of fuel, and this item constitutes one of the important factors of the factory's expense, which must be prorated against the productive departments in the final accounting of the year's expenditures. The cost of fuel, including all labor connected with handling, firing, disposal of ashes, etc., usually represents from 20 to 60 per cent. of the total cost of power, depending upon the size of the station, capacity of the generating units, quality of coal and purchase price at the mines. In the smaller sized stations generating 500 h.p. to 1000 h.p. it may constitute 50 or 60 per cent. or even more of the total cost, as these stations frequently burn hard or semi-bituminous coals. In the bigger industries where soft coal is almost universally used, the fuel burden may represent only 20 or 25 per cent. of the total cost of energy.

In conducting investigations into the initial cost of coals preliminary tests or analyses should be made to determine the percentage of fixed carbon, sulphur, ash, volatile matter, etc. Semi-bituminous coals possess a greater amount of fixed carbon than bituminous, and in many of the former the percentage of volatile matter is less. The percentage of sulphur varies greatly in different kinds of coal, as well as in different localities, and this should receive consideration and tests be made to determine its proportion. It is not economical to use coals which show a high percentage of sulphur. The repairs to grates caused by their use will neutralize in great measure any reduction in price, and the delays consequent upon the stoppage of fires have also to be considered in the estimate of loss. The amount of ash is also of importance, and this varies considerably in the different grades, and also in coals of different localities. Some percentage of ash is necessary to prevent the burning out of grates. A maximum of six or seven per cent. should be a fair proportion.

Semi-bituminous or bituminous coals which develop the highest number of heat units are unquestionably the most economical and desirable, provided the other elements mentioned are within certain limitations. The manufacturer who has been buying his yearly supply on recommendation will find it to his advantage to have small sample lots forwarded, and proper tests or chemical analyses applied, to determine the degree or proportion in which the various elements exist, before his purchases of the year's stock are made. The question of transportation rates, where the consumption is large, although of importance, should be considered secondary in many, if not most, cases to that of quality of the fuel consumed.

Selection of Coal

The selection of coals for testing should be made with a good degree of judgment and care. It is most important that the samples for test be obtained from average mine lots in order that their fuel value may be correctly ascertained. The term bituminous covers a wide range in its application, and the coals designated under this general classification vary greatly in steam raising qualities. It is necessary, therefore, that the manufacturer know the proportions of moisture, volatile matter, fixed carbon, ash, and sulphur before laying in his yearly supply. Some coals, known and classed as bituminous, contain so high a percentage of moisture as to approach lignitic coals, and yet these coals properly belong under the bituminous classification.

The briquetting process bids fair to open up a new and important field in the harboring of our fuel resources, and to effect a most valuable saving in our coal consumption. Government tests show that a good fuel in the form of briquettes can be made with anthracite culm and a small percentage of pitch, or with culm and coking coal mixed, and a small proportion of pitch (not exceeding seven per cent.), which promises to be commercially practicable when the cost of producing is considered. The fact that large amounts of culm have gone to waste in previous years, and that it is still judged of little relative value, renders this process all the more important and worthy of consideration.

Maintenance and Supplies

Economy in maintenance and supplies is a necessary element of successful power-house practice. In the small station these items constitute a relatively higher percentage of the total cost of power than in stations of larger type serving large industries. Repair parts, belting, packing, waste, oils, and other items of supplies are purchased in limited quantities and at a corresponding increase in cost price. Repairs are often made at a disadvantage and without proper facilities close at hand—usually in one of the manufacturing departments or in some outside repair shop. Annoying delays and costly shut-downs frequently result. Because of these disadvantages it is necessary that the engineers in smaller stations exercise the utmost care to keep engines, boilers and other station equipment in the best condition possible at all times, in order to reduce the expenditures for upkeep as much as possible and avoid interruptions in the supply of power to the shops.

In the modern power house of the large type the items of maintenance are numerous and represent a large yearly expenditure. This may average approximately 15 per cent. of the total cost of producing power. It is essential, therefore, to have experienced machinists and repair men, including steam fitters, boiler makers and blacksmiths, connected with the station to make repairs quickly and with the least interruption to service. It is good practice to have a repair department located within the station or adjacent to it, equipped with one or more lathes, shapers, drill presses, pipe cutting and threading machines, forges, and other equipment to make the general run of repairs immediately.

Repairs in the power house are usually of greater importance and urgency than in any other section of the plant. A shut down of a generating unit or other important part of the station apparatus is liable to cause a serious stoppage of productive work in one or several of the manufacturing departments. Engines or turbines, generators and auxiliaries should receive careful daily inspection by the engineer and be kept in good working condition at all times, in order that serious breaks and delays may be avoided. Special attention should be paid to lubrication, not only of the bearings of generator sets and of engine pistons and cylinders, but of all the smaller working parts and appliances.

In the boiler house there is constant need of inspection and repairs to maintain the high pressures and ratings required at the present time, especially in the big industries. Boilers should be cleaned regularly—at least twice each year, according to local conditions and the condition of feed water, etc. Pumps and condensers, piping and appliances, all require regular daily inspection to insure that valves and joints are in proper condition, packings in good order, and that no losses are occurring to reduce the efficiency of operation or rate of steam production. Coal crushers, coal and ash conveying machinery, stokers, etc. must also be kept in condition to obtain uniform and uninterrupted service absolutely essential in a power station.

Weekly Inspection Reports

It is good practice to have regular weekly inspection reports made out by the operating engineer, showing the condition of both the generating apparatus and boiler room equipment, and indicating the character of repairs, if any, necessary to be made.

Maintenance and supplies in these larger types of stations usually represent a considerable item of expense during the year, and include a large amount of materials, both for the upkeep and for normal daily operation. Repair parts for the generating sets, turbines and auxiliaries, boiler fittings, valves, grates, piping and various small appliances, belting, packing, oils, waste, cleaning compounds, etc., all enter into the sum total of power-house expense. On account of the larger quantities purchased the cost of these materials is usually considerably lower than in the smaller type of station, but the yearly expenditure constitutes an important fraction of the total cost of operation, and renders necessary a careful supervision in their handling, use and distribution.

Records and General Reports

It is essential that complete records be kept of all items relating to power production, in order to determine satisfactorily the efficiency of operation and the cost of manufacturing and distributing energy to the shops. Without such data no uniform basis of pressure or loads can be satisfactorily or economically established and maintained.

In the boiler room, records should be kept to show the daily consumption of coal, feed water, supplies, repair materials, etc., the steam used for feed pumps and boiler room auxiliaries, also the total amount of steam produced, pressure and loads carried. and the distribution to the engine room for engines and turbines (including steam driven auxiliaries) and to the shops for various purposes, such as manufacturing and testing, live steam for heating, operating pumps for fire and water supply, etc. Record should also be made of the factors of superheat and evaporation, of flue and stack temperatures, chimney losses, temperatures of feed water, etc. Account should be kept of all labor expenditures for supervision, firemen, conveyor operators, boiler cleaners, coal handlers, etc., and for the various items of maintenance such as repairs to buildings, boilers, conveyors, stokers, feed pumps, piping, cranes and all boiler-room auxiliaries and apparatus.

In the engine room it is essential to keep accurate account of all items of operating expense such as steam used in operating engines, turbines and auxiliaries, materials for supplies and repairs, etc. The output and distribution must be daily recorded. This should include exhaust steam used for heating, total kw. hours generated, amount of energy delivered to the shops for manufacturing, lighting or other purposes, and current delivered to outside customers wherever power is sold. As in the boiler room, account should be kept of all labor charges, to include the wages of foremen, engineers and turbine operators, switchboard and dynamo tenders, oilers, sweepers, etc., and all expenditures for maintenance and upkeep such as repairs to buildings, engines and turbines, auxiliaries, electrical apparatus, cranes and miscellaneous items of expense and repair.

A group of series of power house order numbers should be issued against which to charge the various classes of labor and materials enumerated, both for the engine and boiler room, thus simplifying records.

Periodic Comparison of Expenses

A diagram of curves showing loads carried at various periods during the year furnishes valuable aid in a comparison of expenses between the different periods of the same year, or between like periods of two or more years. Allowance will always, of necessity, be made for varying conditions and requirements as to load carried, when comparing like periods of different years, such as abnormal increase or decrease in plant productive output and varying conditions of weather and temperature.

Reports covering various phases of operation are essential in determining the economy and efficiency of the station in the production of power. A regular weekly report of steam and coal consumption is useful. This report may be prepared so as to show the daily and weekly consumption of feed water, also temperatures, gage pressure, blow off, evaporation, etc., the amount of steam delivered to engines and turbines, to pumps for various purposes, to steam mains for manufacturing and testing, live steam for heat, radiation and condensation and the daily and weekly consumption of coal. In addition to this, regular monthly reports should be prepared from the records giving a general itemization and apportionment of all expenditures both in the boiler room and engine room, to include consumption of feed water, fuel and steam, supplies and repairs, labor on supervision, operation and maintenance and fixed charges (including depreciation, taxes, insurance, factory assessment, etc.). The output of the station in steam and electrical energy should be classified in the report, giving both total production and a segregation of the distribution, such as delivery of steam to engine room for operation of engines, turbines and auxiliaries, to pumps for fire and water supply, and to mains for manufacturing, testing and heating; the delivery of exhaust steam from non-condensing units for heating purposes, and of kw. hours to the shops for manufacturing, testing, etc., or to outside customers on contracts.

With a properly established system of records and carefully prepared reports it will be evident that each item of power-house expense can be readily analyzed and judged on its individual basis or merits, separate and apart from the other expenses of the station. This is one of the chief values of all analyses of factory expense, as it often opens up to light weaknesses and losses which would remain undiscovered in any system which involves the pooling of labor or material charges. With proper records and reports the manager is in a position to determine the economy and efficiency of power-house operation with the same facility with which any other item of industrial operation may be adjudged or determined.

Master Control of Industry
By Thomas Robson Hay

THE leading article, "An Industrial Achievement of the War," in the February issue of INDUSTRIAL MANAGEMENT, calls timely attention to some of the work actually accomplished by the much-abused Ordnance Bureau of the Army, together with a clear statement of some of the methods in use. The leading editorial, "Master Control of American Industries," in the same issue, suggests a feasible plan for coördinating the war-time activities of our Government into a unified whole and at the same time visualizing day-to-day conditions.

The mere fact that there were only 11 officers on duty at Washington in the Ordnance Bureau when war broke out, and that now there are over 1,600, speaks volumes for the personnel nucleus. A mere mention of the many items of ordnance material will convey some conception of its magnitude and diversity. This condition, however, does not alter the fact that even before our entrance into the war the powers that be, political and military, knew that the existing organization, not only of the Ordnance Bureau, but of all other supply departments, was woefully inadequate.

A PRIMARY NEED

The primary need for all departments and divisions is a unified coördination of purchasing, production and delivery. Attention has been called in the article mentioned, to one point only, that of specific organization, which, in truth, is only one of several necessary fundamental factors. Another point that should be emphasized, and without which any amount of specific, individual organization would be useless, is the imperative necessity for intimately coördinating all the different departments and divisions. In other words, consider munitions as a whole, whether food, clothing, ordnance supplies, or what not, visualize this whole, with especial regard to demand, supply and transportation of the terminal and shipping facilities.

The emphasis on the dangers that will result when deliveries begin to take place is most important. Not only will the initial deliveries be in great amounts, but they will be followed by a continuous and never-ending stream of finished products. As soon as this condition is reached, unless foresight is exercised, our present congestion, not only at the seaboard, but also in the central distributing yards, will be so great as to make any present congestion seem insignificant.

GRAPHIC ANALYSIS

We must have a master control of industry that will make sure that goods are delivered when, where and as needed. Otherwise the congestion at Vladivostok will seem puerile beside what will exist at some of our seaboard shipping points. Graphic analysis of all the facts in regard to the production of Government material will give a managerial control that will visualize requirements and regulate output and deliveries.

To control distribution, without restricting output, the flow of finished product to the point of delivery could be closely regulated by the establishment of control distributing warehouses, capable of caring for a variety of products and so situated as quickly and easily to drain a given locality. Such a warehousing arrangement besides enabling production of individual factories at any desired rate of output, would act to reduce car demurrage charges and car shortage, and would greatly relieve tidewater terminal and shipping facilities. Properly stored and cared for equipment would be subject to a minimum of depreciation and would always be available for instant shipment to any desired point. This arrangement would, in the long run, certainly be cheaper than the losses resulting from terminal and yard congestion and rapid deterioration of materials due to inadequate and improper storage.

MASTER CONTROL

Such a master control when applied to all sections of the Government engaged in industrial work would necessarily coördinate and unify all the component parts. The chairman of each departmental committee will attend to and adjust the supply to each division of his department. Each departmental chairman will be a member of a superior council whose chairman will be the secretary, or director of munitions and who will have executive authority and the power of administrative action. This chairman should be responsible to the President only. It would be his duty to equate the demands of the individual departments and divisions to the supply. To enable this clearance committee to work to the greatest advantage, the activities of the several supply departments and of the fuel, food and railway administrations, the Shipping Board, etc., must achieve a close and real coördination with the military plans and activities of the general staff.

This war is the biggest busineess proposition that has ever been known in this country. Let us manage it along up-to-date business lines, and in full coöperation with military plans and policies. Put the best men where they can do the most good, regardless of age and political affiliation. Keep politics out from the start and not wait to eliminate it after many lives and much treasure have been sacrificed because of interference in the proper and efficient military and business prosecution of the war. Time presses and the war will not wait.

A "War Emergency" Near Home
New York Herald

New York State's great waterway from the Hudson to the West Lakes, which will be completed by the middle of May, is to remain unused during this critical year of the war, with its super-demand for transportation facilities.

It is evident, however, that this great canal from the Hudson to the lakes and which has cost the people of the State about $150,000,000 will remain unutilized unless the Legislature acts quickly to provide for its equipment. Those 2,000 ton barges about which we have heard so much have not materialized, and at latest accounts even their design had not been decided upon.

* * *

To permit this vast and costly public work to remain idle in time of peace would be most reprehensible: it is a crime in this time of war, when the railways are overpressed and tonnage between the interior and the seaboard is a crying need.

Employment and Labor Maintenance

A Special Department to Aid Employment Executives

Methods of Arriving at Labor Turnover

By J. M. Van Harlingen and T. J. Dwyer

THE following discussion deals with some methods employed in arriving at what is known as the labor turnover. From the number of methods now used by various concerns in figuring "turnover" it would appear that it is not clear just what is meant by this much used term.

In merchandising, the term is generally understood to mean the number of times that a stock is changed over from the standpoint of sales. If a $1000 stock is completely replenished or sold in four months, the annual rate is 300 per cent. and this represents the rapidity with which this merchandise is disposed of. Taking into consideration the money value as well as the quantity of stock, quick turnovers and small profits are desirable and large fortunes have been based upon this ability to make rapid exchanges even though the margin of profit is small. From an employment viewpoint the reverse is what we want. The smaller the turnover, the more successful the management. Since it is most undesirable that there should be even an annual employment "turnover" it is the belief of the writers that the word "turnover" is unfortunately used as related to employment, and that another term might be more descriptive and better suited to the conditions as they really exist at the present time.

Rate of Replacement

Turnover as at present figured is, or should be, the rate of replacement. It is the figure representing the relation between the number of men who are hired to maintain a given output or production (and are therefore hired to replace those leaving) and the total force to be maintained. It is expressed as a percentage of the total force.

As the force maintained in the average plant is constantly changing in size, the period over which such a force may be assumed to be constant is a matter for discussion. The length of such a period is a matter for individual judgment, but it is safe to assume that unless unusual changes are taking place constantly a monthly figure will prove accurate enough to answer for purposes of comparison and, what is more important, as a check against excessive changes in the force.

To obtain correct replacement figures for a plant or a department of a plant we must first know the force that is required to operate it, and then know the number of men hired to replace those leaving during a given period. We should ignore those who are hired to increase the force as having no bearing on the maintenance of the original number employed.

An Illustration

To show the difference in results that may be obtained through a number of methods used in figuring the replacement, or turnover, let us assume a replacement of 10 per cent. a month, based on the number of men employed at the first of each month and a monthly increase in force of 10 per cent. over the preceding month.

Table 1 shows the result of this assumption which gives an annual rate of 120 per cent. based on this regular monthly replacement. The relation of the factors upon which this is based is shown on Chart 1.

TABLE 1.—LABOR TURNOVER FIGURED ON A MONTHLY BASIS

Month	Number of men working	Increase in force	Total number of men hired	Men hired to maintain force, not including increase	Monthly turnover	Annual turnover based on rate this month
					%	%
January......	1000	100	200	100	10	120
February.....	1100	110	220	110	10	120
March........	1210	121	242	121	10	120
April........	1331	133	266	133	10	120
May..........	1464	146	292	146	10	120
June.........	1610	161	322	161	10	120
July.........	1771	177	354	177	10	120
August.......	1948	195	390	195	10	120
September....	2143	214	428	214	10	120
October......	2357	236	472	236	10	120
November....	2593	259	518	259	10	120
December....	2852	285	570	285	10	120
			4274	2137		

If, however, we figure on an annual basis, ignoring the monthly figures, that 1,000 men are the required force to be maintained from the beginning to the end of the year we should then make the following calculation:

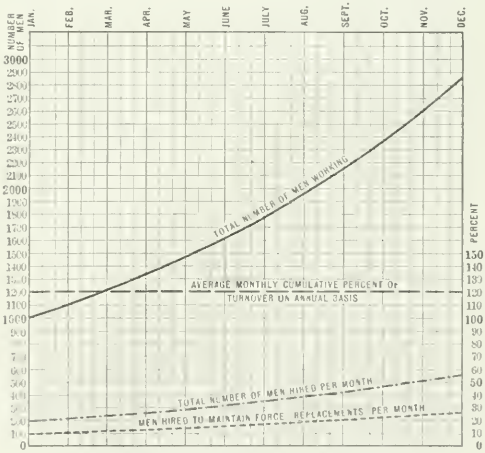


CHART I.—RELATION OF FACTORS OF MONTHLY TURNOVER

Number employed at the end of the year,	2,852
Number employed at beginning of the year,	1,000
Net increase	1,852
Total number hired	4,274

The total number hired minus the net increase equals 2,422 replacements. This would give us the figure of 242.2 per cent. replacement which is obviously incorrect as we assumed the rate of turnover to be 10 per cent. per month, even though the number to be maintained constantly increased.

In some cases it is considered desirable to base the turnover on the average number of men employed over a given period. If this were done in the above instance we would base our calculations on an average of 1,926 men, and our turnover would amount to 125.6 per cent.

Daily Fluctuations

We have not taken into consideration in the above the daily or weekly employment which meets a constantly fluctuating demand for replacements and an increasing or decreasing force to be maintained. It seems reasonable to assume that if a monthly rate of replacement is more accurate than a yearly, a weekly or even daily record would be still more accurate. To test this reasoning we have assumed a month of 25 working days divided into four weeks, as shown on Table 2. Table 2 shows that the yearly rate of replacement based on the number of men hired during the month to maintain the force is 98 per cent., although the increase in forces and the total number of men hired corresponds to the January figures in Table 1, which resulted in an annual turnover rate of 120 per cent.

However, if we consider the weekly replacement for the same month we find that the annual rate is 124.8 per cent., while by using the daily figures for the same month we get an annual rate of replacement of 112 per cent.

Chart 2, based on the figures given in the above table, indicates the amount of fluctuations which occur daily in the figures and indicates that the turnover percentage reduced to an annual basis fluctuates during the month to such extents that no single day's figure is indicative of the conditions except for the 24-hour period which it represents. There may, however, be some circumstances under which this close knowledge of daily conditions is desirable. It would seem, therefore, that the choice of methods is simply a matter for individual selection and requirements of each case.

A monthly figure is to all intents and purposes quite accurate enough for most cases, unless we know the history of each individual replacement.

Influence of Long Service

To determine properly the rate of replacement the length of service should be taken into consideration and a thorough study of the employment problem cannot fail to include this item in its calculation.

A plant having, as described above, a replacement of 120 per cent. per annum might be assumed to have no one in its employ for a year's time, but this we know to be rarely, if ever, true. Indeed with this figure as a replacement the records may show that more than 40 per cent. of the total number of men employed at the end of the year may have been in service a year or more. Would it not seem reasonable to take into consideration this fact in making our calculations as to the number of replacements which actually take place?

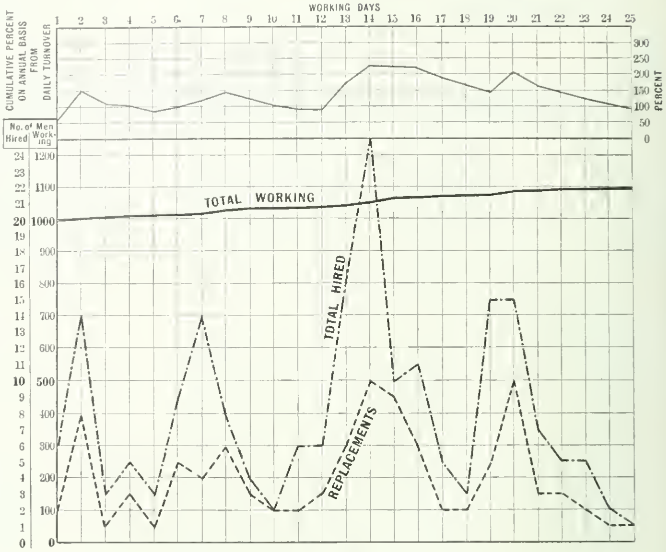


CHART 2. FLUCTUATIONS IN DAILY TURNOVER

For example, 1,000 men are employed throughout the year of whom 40 per cent have been in the employ of the company for a year or more. Clearly we have not been employing men to replace this 40 per cent. of

TABLE 2.—LABOR TURNOVER FIGURED ON DAILY AND WEEKLY BASIS

Number working	Increase or decrease	Total hired	Men hired to maintain	Daily turnover	Annual turnover, daily rate	Cumulative average of turnover, daily rate	Weekly turnover based on employees at first of week
1000	4	6	2	0.2	60	60	Weekly basis:
1004	6	14	8	.79	237	148.5	20 men is 2%.
1010	2	3	1	.09	27	108	2x52 is 104%.
1012	2	5	3	.28	84	102	
1014	2	3	1	.09	27	87	
1016	4	9	5	.49	147	97	
1020	10	14	4	.39	117	117	Weekly basis:
1030	2	8	6	.57	171	144	20menis1.9%
1032	1	4	3	.25	75	121	1.9x52 is 98.8
1033	..	2	2	.16	48	102	%. Average
1033	4	6	2	.15	45	91	days for two
1037	3	6	3	.26	78	89	wks. is 84.7%
1040	10	16	6	.58	174	174	Weekly basis:
1050	15	25	10	.95	285	229	35menis3.4%
1065	1	10	9	.84	252	227	3.4 x 52 is
1066	5	11	6	.56	168	220	176.8%
1071	3	5	2	.19	57	187	
1074	1	3	2	.19	57	166	
1075	10	15	5	.47	141	141	
1085	5	15	10	.92	276	209	Weekly basis:
1090	4	7	3	.27	81	166	25menis2.3%
1094	2	5	3	.27	81	145	2.3 x 52 is
1096	3	5	2	.18	54	127	119.6%
1099	1	2	1	.09	27	110	
1100	..	1	1	.09	27	98	

Cumulative average by days	112.0
Cumulative average by weeks	124.8
Turnover for this month	98.0
Assumed annual turnover	120 0

the total; but to sustain a floating force of 600 men who come and go during the year perhaps we have hired 1,200 men. Now, following our method as given in Tables 1 and 2, our rate has been 120 per cent. This is doing an injustice to the faithful 40 per cent. and beguiling ourselves into considering that our condition is better than it really is. In reality has not our replacement in moving "stock" been nearer to 200 per cent. than 120 per cent.? We are hiring against a floating force of 600 and not against our steady 400 employees who have a year of service to show.

Analyzing the employment records of a number of large concerns, it may be found that a large percentage of replacements are made of men who have been employed between four and six months. Where then is the justice of a calculation based upon that portion of the force who are steadily in the employ of the company?

The justification of statistics is the use that is made of them and the result that may be obtained through a study of the conditions which they represent.

It should be the aim of an employment department to so study the conditions of hiring and replacing men that the number of men hired, except to increase the force may be reduced.

Statistics of employment should answer the following questions:

1. Are the employees hired staying in the service a longer or shorter time than they did a year ago?
2. Are the number of replacements becoming greater or less month by month?
3. Is there a distinct seasonal fluctuation which must be met?

The progressive employment manager, knowing these facts through his records, will search for the reasons, and his records must be based on true conditions or his conclusions will be faulty. For this reason replacements are individual substitutions and should not be grouped or compared with the whole force, but only with the unstable portion of it. Then we shall have a true replacement figure on our human stock.

How I Landed My Job

By L. A. Terven

No long ago I was faced with the rather prosaic task of looking for a job. Changes in my business due to the war had rendered it desirable for me to dispose of my interest in it and, as no other opportunity for entering a business of my own presented itself, I set about finding a position in as nearly a scientific and systematic way as I knew how.

From conversations with my better half I was convinced that she wished to return to the Northern States, and would like to live again in a large city or its environs. Knowing my own ideas of what I wanted and what I was best adapted for, I formulated the following ideals as to the position I sought. Such a position should provide:

A fair salary, say, $...... per year.
A good opportunity for promotion.
A number of duties agreeable to my nature.
A pleasant locality for myself and family.
School advantages for my children.
Social advantages for all of us.
Duties for which I am fitted.
Hours of work which will allow time for social duties.
A wholesome mental, moral and physical atmosphere.
A locality where the cost of living is nominal.
Dwelling and place of business convenient.
Permanency of situation, and perhaps old age benefit.
Opportunities for keeping abreast of the times, such as access to reading rooms, museums, art galleries, auditoriums of music and for rubbing up against my fellow engineers.

While one may think the ideals above to be very exacting they are certainly not unreasonable, and we should always aim high. Any proferred situation could be carefully checked against the list and perhaps graded on a percentage basis, using an artificial standard as 100 per cent. For instance, a position in South America at $3600 per year would be on a footing with one in a desirable part of the United States for $2400, as the former would demand a long move for my family, higher living cost, greater danger of disease, and school advantages for the children would be difficult to obtain.

The above list served as a standard which I had set for myself. I added the qualifications which I possessed for various classes of work, indicating in what lines and in what capacities I believed I could show enthusiasm and well earn my salary. On that basis I made carefully tabulated lists of the various lines of work, of the different firms, advertising agencies, and technical papers publishing "Situations Wanted," as a start for my search. The firms were roughly divided into jobbers, machinery manufacturers, export houses and general engineering concerns. The positions for which I might qualify were classified as salesman, engineer, superintendent of construction, as well as for estimating or supervising engineer.

Returns From Personal Letters

Personal letters were addressed to a well selected list of 65 names, giving full particulars and I considered so worded as to appeal to the undertaking concerned. For instance, in writing to a manufacturer, my past experiences in that line were emphasized; when writing to a general engineering firm I dwelt upon my services in that field and upon my practical utility for construction work. Of the 65 firms addressed some 48 replied. All the answers were in the negative so far as revealing an opening was concerned. Follow-ups were sent to seven who had not answered the first letter. Of these six answered, no situation being indicated. No opportunity for employment was found. One concern wrote that I might call on them if I chanced to be in New York City. That was the closest to an offer that I had.

The number of answers received I consider as a good indication of the drawing quality of the letter, and also of the fact that one can still solicit a position by mail with a reasonable assurance that some of the firms addressed will give the application a measure of consideration. The jobbers were the most courteous in their replies. This may be due to my having been a dealer, and a jobber never knows when a dealer may become a purchasing agent for some large buyer. Manufacturers did not dignify me with a reply with the exception of three who answered follow-ups. General engineering firms answered courteously and kindly, which is a credit to their treatment of a fellow engineer.

Need for Technical Men

Since becoming employed I have found that manufacturing concerns are sorely in need of good technical men, and it is astonishing that their employment departments do not reply to applicants who live at a distance. It would appear that they could well afford to keep in touch with all desirable prospects who apply for work through the mail. In case of necessity they might be able to secure men without expensive recourse to advertisements, employment bureaus and similar sources.

As formulated, the plan was to carry out an intensive campaign of personal letters on the list of prospects, followed by personal calls. "Situations Vacant" advertisements in technical papers were answered, and two advertisements in the "Situations Wanted" columns of reputable technical weeklies were inserted. As the mail was very slow I decided to cut the campaign short and call upon those prospects located in two of the largest cities. I thought that perhaps I could take a simple position at half pay, if necessary, while waiting for answers to come in from the different sources concerned. In this way I would be nearer my base, because I started out in a small Southern town far away from the cities where I hoped to locate.

Of course, I held myself rigidly to the program selected and kept up with each phase of it as it became due. My own mental attitude was also a matter of close scrutiny. I made it a rule to call on my prospects only when in good spirits. I found myself in best mental condition just after a light lunch or breakfast. Needless to say I shunned tobacco and all drinks absolutely. The rules laid down were recorded on suitable cards and were carried in my hand luggage; although some of the cards were frequently carried in my pocket for hasty consultation.

My Self Analysis

The self analysis of my qualifications and inclinations consumed no little thought, scratch paper and finally record cards. Many discrepancies were discovered in close analysis. For example, I was applying for a position as travelling salesman, but was I really adapted for selling? Could I be happy away from my family for any length of time? Could I withstand the onslaughts of indigestion caused by the customary hotel life? As a matter of fact I finally decided that I could not undertake this calling successfully.

Nor did I fail to index the names of the friends who could help me to get employment. Furthermore, I listed a well known vocation expert upon whom I wished to call for consultation as to the work for which I was fitted. My experiences in the past were tabulated, and as a result of the summary I decided to stick to the work to which I had grown accustomed so far as I could. I had reached the age of application and of doing things and did not care to acquire new and varied knowledge perpetually. This I emphasized because "the grass on the other side of the fence always looks the greenest," and we are disposed to imagine that other lines of effort do not encounter the same difficulties as ours—a natural error.

During my campaign of personal calls I made about ten visits per day. I could easily have called on more, but the nature of the business and being turned down each time, made it desirable for me to limit the number of calls so that in each case I could walk in with a smile and a determination to land something. Each night I would brace up my spirits by a heart to heart talk with myself, being convinced that I would ultimately find employment of the right sort.

Altogether, in New York City, I unearthed three desirable prospects. One came through a letter of recommendation of a friend, one from a letter of introduction given me by a chance acquaintance, one from an employment agency. To my advertisements in the technical papers no response was made. I believe employment agencies to be fairly good when properly pushed at short range, almost worthless at a distance.

As a matter of fact I finally accepted a position with a large manufacturing concern where my ideals were fulfilled with exceptions of the item of salary. This I considered at length and believed that my past experience, confidence in myself and continued application would result in the necessary advancement to a fair income.

My Summary

From my limited experience though rather wide observation, I believe that when a man is out of employment he should try all the means at his disposal to secure a situation and that he should by all means use personal interviews—letters rarely close such a deal. Introductions of friends to their friends, and so on down the line, still produce more results than haphazard asking for employment where no one takes any interest in you. Occasionally your college connections and membership in societies will be of benefit. These remarks apply purely to men of some experience and of some pretentions as to compensation, position, etc.

Changing from Male to Female Help

By W. L. Churchill

With C. E. Knoeppel & Company

THE use of female help to fill emergency contracts for war requirements on work heretofore always considered as strictly male occupations, is becoming almost a commonplace matter. The facility with which many of these changes have apparently been brought about has induced trials that have not been over-successful and, in spite of the gratifying results obtained in noteworthy cases, there are still many who feel that such a transfer is not practicable in their line, even though there is nothing inherent in the nature of the occupation to prohibit the employment of women.

There are three fundamentals in the successful employment of all labor: Selection, supervision and compensation. The neglect of any one of these fundamentals simply increases the burden on the other two. If selection is poor, supervision and compensation become more important and necessary to insure success; if supervision is lacking or indifferent, then selection and compensation are more important; with poor compensation, selection and supervision necessarily increase in training.

These same rules and laws apply to the employment of female labor as well as male, but the standards for selection, supervision and compensation all change. Selection has to be more definite and particularized, supervision more specific and include a larger appeal to sentiment, good-will and loyalty, while compensation standards per unit of result should not be lowered as is so commonly attempted.

The relative importance of any one of these fundamentals increases or decreases according to the importance placed by employers on the other two. Poor selection means increased supervision and compensation to insure success, poor supervision makes more careful selection and compensation essential to satisfactory results, while poor compenation makes good selection and supervision very necessary to the eventual accomplishment of desired aims.

With reasonably careful selection of type adapted to the tasks in hand, supervision that really instructs, serves, assists and encourages the workers, and compensation that makes the employment attractive to female help, almost anything can be accomplished.

A Fair Example

Aptly illustrating these conclusions, the experience of the Robinson-Roders Company, of Newark, N. J., is a fair example. In the manufacture of life preservers previous to our entrance into the war, except for some sewing, the work was done by male labor. On account of the air being filled with fine fibres, thus making the work of filling these preservers rather disagreeable to eyes and nostrils, the grade of male help secured and retained was not very satisfactory. The tufting and finishing was done by journeyman mattress-makers.

With war demands it became necessary to multiply output at once to over ten times the normal pre-war requirements. Additional equipment was quickly installed in a cleared warehouse and by dint of frequent changes in male help, considerable overtime and sheer driving on the part of executives, the output was doubled. But the Government demands were such that radical improvement was necessary to avoid confiscation, or at least cancellation of contracts.

To meet the situation, a production engineer was engaged and an agreement to permit a transfer to female labor secured. An immediate campaign for a sufficient corps of women for the task was started. An attractive advertisement was placed in the local papers specifying the type of women required, the class of work and offering excellent wages. The papers were out at noon and by night 52 women had been selected to start on the following morning; these, of course, were followed by many more on the succeeding days.

Reasonable care was used in selecting robust women who needed money; preference was given to those with dependents, and with the selection and compensation offered, the question of supervision only was left to be solved.

The work was divided into its various components and groups assigned to each under the instruction and supervision of leaders, the leaders being selected more for cheerful patience than for expert ability. Individual piece work was introduced for sewing machine operators, rates based on the supposition that operators would be supplied with material, and finished work taken away from them continuously.

The filling was sub-divided into weighing, filling and verifying, with separate groups to each, but all on a collective piece-work basis which also included foremen and the sewers and cleaners.

Tufting was sub-divided into equalizing, stitching and typing-down, handled by competitive groups each on a collective piece-rate basis.

Men were used for baling which included brushing and inspecting, and these men were also on a collective piece-work basis. Foremen were given bonuses on the basis of quantities shipped.

Four days after starting the quantities being produced were such as to insure completion of contracts on time, but a fire, compelling suspension for a few days, made a still larger daily quota necessary to enable completion of contracts within the days specified. This quota was quickly reached and the original contracts completed several days ahead of the specified date and additional contracts taken, calling for a doubling of daily output, which was likewise secured and the entire Government requirements were met promptly and as agreed upon.

Care in Selection

This was seemingly simple enough but the result was secured only by an observation of the fundamentals. The type selected was adapted to the work and willing to work in the disagreeable surroundings for the rate of compensation offered. This, in turn, was sufficiently attractive to overcome objections to lack of many ordinary comforts and conveniences impossible to introduce for lack of time.

The selection at first had naturally to be less exacting than was possible when it became noised abroad that excellent wages were earned. Then more people presented themselves for consideration enabling a replacement of the inefficient and otherwise unsatisfactory workers with better or more promising material.

The continuous development of speed through practice, and the consequent enlargement of earnings, naturally tended to make selection and direct supervision more and more automatic, but also developed a temptation for cost reduction that required considerable courage to resist.

Compensation a Chief Factor

In this particular instance, compensation became the chief factor in the development of quantity. Any depression of earnings would automaticaly have lowered output.

The conveniences to add to the comfort of the workers were conspicuous by their absence. On account of the air being filled with the fine fibres, the employees were obliged to wear silk gauze veils over mouth and nostrils and automobile goggles to protect their eyes. Uniform overall aprons and caps were provided and stools to enable the majority to sit at their work. Electric fans to help make the temperature more bearable, and a cleaner with suction hose to keep the waste gathered up from the floor and minimize the flying dust, were installed, and the working hours reduced to enable a maximum exertion through a short day. In spite of the fact that we were in direct competition with industries providing ideal surroundings and catering to the comfort and pleasure of their employees by means of the most modern and up-to-date rest rooms, lunches, recesses, matrons, manicures and all the advantages possible with a highly developed organization, we had no difficulty in maintaining a full complement of eager workers, even through the extremely hot period that forced many of the more highly organized plants to suspend operations.

Another Experience

While in the midst of the production of life preservers, the firm was also called upon to provide floating mattresses—a distinct addition to their regular line of products and in quantities far in excess of their normal capacity even if their regular commercial business was suspended. After unsuccessfully advertising in the principal nearby cities for expert mattress-makers in sufficient numbers to meet the requirements of the Government, practically the same procedure was repeated in building up mattress manufacture.

Here a more radical departure from established methods was necessary, as the limited amount of available space secured by emptying another warehouse floor would have been inadequate to produce the required quantity in the time allotted, even with a sufficient force of skilled mattress makers. The standard mattress making equipment consists of a table for each man, the table being slightly larger than the mattress to be made. As it would require fifty of these tables to produce the quantities required, it was necessary to change the methods to accommodate the space in which there was room for but eight standard tables.

To do this the tables were split and doubled in length and each mattress, after filling, was placed on one-half where four women, two on each side, stitched in the tufting threads, then slid the mattress to the other half of table where three other women tied the tufts down, thus enabling seven women to work per table, instead of one as on the old standard. This also enabled greater specialization as the women learned only to do one thing and soon acquired speed in that.

Mattresses were filled by machinery, then equalized by male labor and the dust kept out of the making room by delivery only after they were filled and beaten out. Here two women marked all the patterns and distributed to the waiting tables; when finished, men carried the mattresses to the balers.

So rapidly did these women acquire proficiency that starting with a serious handicap they were able to finish all contracts well ahead of the specified date.

Here again, selection had to be made with judgment for although the atmosphere of the department was much better than that of the life-preserver division, there was little opportunity to secure rest by sitting down and only women able to stand most of the time could perform the tasks satisfactorily. Supervision was made comparatively easy by good selections and liberal compensation. A satisfactory class of employees was secured despite the dearth of conveniences, lack of comforts and the unsatisfactory surroundings.

Both of these cases were recognized and treated as strictly temporary emergencies. No effort was made to reduce labor costs below the established contract figures on which the work was secured.

Among the many gratifying features developed in this introduction of female labor into emergency work, was the cheerfulness with which they submit to temporary interferences in production, willingly remaining away from work until the interference had been removed and returning with full enthusiasm when the task was ready.

Employment in Small Plants

By Allen L. Adams

MUCH has been written and said about employment and allied problems in large plants; hence, many have conceived the false idea that it is useless to attempt to accomplish anything along this line in a small organization. This belief, however, is incorrect: the smaller the plant the greater the need of congenial relations between the management and the help, as the attitude of the individual has relatively much greater weight than in a large concern.

The small industrial unit is generally managed by the owners, and labor problems easily become matters of personal enmity between owners and workmen; whereas, in the large plant under corporate ownership both the management and help being employees, personal bitterness is more easily avoided. On the other hand, a small organization properly handled will possess an efficient team spirit that is so hard to create where labor is employed on a large scale. It is true that the larger the plant the greater the detail it is necessary to keep on file, as a personal acquaintance with each employee is an important factor of this work in small plants.

The management will often state their force is so small that all important facts can easily be remembered, but a little questioning will reveal the fallacy of this statement. The reports now required by Federal and State laws are opening the eyes of many to the value of definite employment records.

Managements of "the ancient, hide-bound type," refuse emphatically to have anything to do with "employment and management schemes," without realizing that in reality they must have some basis on which to operate—no matter how ill-advised or unsystematic it may be. No definite work may be done along standardized lines, but a business cannot exist unless this function is present, although it may be carefully disguised or separated from other important matters.

CENTRALIZING EMPLOYMENT

The fact that only a small number are hired is all the more reason for centralizing the selection function at one point. The time to standardize any function is while it is still small and all detail easily understood. Most small businesses have a greater future before them, and in a comparatively short time many will outgrow the "small" classification. It is best to look ahead in this as in any other phase of business and anticipate the needs of the future, if we wish to void unpleasant complications.

Any operation that is repeated over and over, as the employment and training of employees, can always be handled in one best way. The value of any code of ethics rests largely in predetermining what should be done under certain conditions, and not acting on the impulse of the moment. If experience shows that our predetermined decisions are incorrect we may, of course, alter them as our judgment dictates.

All employment work may be grouped under five general headings:

1. Pre-employment and records.
2. Examination and selection.
3. Training new and transferred employees.
4. Regulating permanent employees.
5. Weeding out and transferring or rejecting those misplaced.

It is the care with which pre-employment and record work is done that determines the success or failure of the whole structure of employment work. As with any other endeavor, carefully considered plans prevent blunders. These plans will necessarily vary with the nature of the plant and the class of help employed, but the essence of the whole matter is the attitude of the firm toward the entire body of employees.

NEED OF A POLICY

A definite policy should be adopted so that all employees may know just what to expect. Uncertain policies cause distrust and dissatisfaction resulting in inefficient and unreliable help. The basis of any successful policy must ever be the "square deal," guaranteeing to each a fair reward for the energy and intelligence contributed. It is preferable to put the policy in writing, carefully worded, for future reference, to avoid misinterpretation.

An organization chart is very valuable, showing a general survey of all the different jobs in the plant and their relation to each other. It should represent clearly the lines and limits of authority. In small, unorganized plants, conflict of authority is usually one of the greatest sources of trouble. No human being can "serve two masters" satisfactorily.

To select successfully for any job, it is necessary to know the requirements of that job—hence the necessity of job analysis. Having determined the qualities that a workman should have in each position in the factory, the next step would be the planning of the requisition slip to be used by the foreman when requesting the addition of an employee to his working force. Where job analysis has been carefully done, all that it is necessary to put on one of these slips might be: "2 men, job 54." The employment man, having the job analysis in his office, immediately knows just what qualities are to be looked for before selecting men for the positions open at any time.

Records of Employees

The very essence of any employment scheme is definite and immediately available records pertaining to each employee. The folder or envelope method of handling these records is generally conceded to be the most satisfactory. A folder or envelope is provided for each employee, and all records pertaining to him during the course of his employment are placed within this envelope or folder. Generally a master card is provided giving the name, address, signature, date of birth, record of accidents, changes in rates of pay, termination of employment and reasons, etc.—the data varying according to the requirements of the plant.

Thought should be given as to possible future requirements when obtaining these records. What information will be of value when the plant has doubled or quadrupled in size?

Often efficiency cards showing the workman's efficiency from month to month are kept. Records of errors and suggestions may also be inserted in these folders.

Examination and Selection

The examination and selection of employees should be done as far as possible by the one person who is best suited by his broad comprehension of human nature to perform this task. He should make a study of the requirements, as shown by the job analysis records, and always endeavor to secure the person best suited to perform the task. Character analysis and psychological tests may not be a "cure-all," but a careful sizing up along some definite system is necessary. Many of the foremen who hire in small plants seem to believe the theory cited by one foreman: "In order to get one good employee, you must hire six and take a chance; it's all a blind grab in the dark, anyway."

Intelligent employees should be required to make out their own applications, as a line on their intelligence can be obtained by the way in which the blanks are filled out. In hiring unskilled and uneducated employees it will, of course, be necessary to make out the blanks for them. Many find it of value to have printed on the back of the application form a list of the qualities desired, and check to show how the applicant "sizes up."

Introducing the Newcomer

The applicant, having been hired, should be carefully introduced into his department so that he will feel that he is a part of the organization. New employees when left to themselves are very apt to quit, for no other reason than a feeling of strangeness or homesickness to which they are subject during the first few days.

Printed instruction booklets giving the employee an outline of what is expected in that particular plant are of value in many cases. Those who are to teach the new new employee should be selected for their teaching ability, not simply because they happen to be one of the largest producers in the department. The idea should be to train the employee in doing his work in the one best way that experience dictates.

Caring for Permanent Employees

The regulating of permanent employees is work that must be done constantly. Many petty difficulties arise that it is necessary to iron out, and means must be taken to prevent their recurrence. Rates of wages and wage schemes must be considered, not only from their dollars-and-cents value to the firm, but how they appeal to the human element. For instance, in a certain corporation the bonus method of payment was tried with the result that the employees struck and demanded piece work. A piece-work scheme was arranged, giving to the employee practically the same amount of money per week as was done under the bonus arrangement, and it was perfectly satisfactory to the help. Their objection to the bonus was that they could not understand the conditions upon which their pay was figured, and they wanted to know from hour to hour and from day to day just how much wages they had earned.

If an efficient standard of work is to be maintained, it will be necessary to weed out the inefficient and either transfer them to some other department where their services will be of value, or discharge them from the plant. In cases where employees are loyal the transfer method should be used as far as possible, but there will always be some who are trouble makers or who are wholly unsuited to their surroundings or the industry and must be rejected.

Some of this work necessarily falls on the shoulders of the foreman, but it should be the duty of the employment department to study carefully the efficiency of each employee. By careful observation, "kickers and self-appointed floor walkers" can be eradicated; in their place enthusiastic employees loyal to the management can be secured. A study of the ebb and flow of orders and product will enable help to be trained for efficient work a little ahead of the rush season, instead of training them in the midst of it as is usually done today.

Applications should never be taken unless there is some possibility of employment. It is better to tell people frankly that there is nothing for them than to have them come several times to follow up an application. Applicants who cannot be used, and discharged employees as well, should be referred to public employment offices, where their chances may be better.

Broad Viewpoint of Employment

In the earlier stages of employment work, the management and the employment man were apt to consider questions of employment from an entirely selfish standpoint, as applied to their particular concern. Today many are beginning to realize that it has many broader features, which not only affect any particular concern, but also the locality, the community and the nation as a whole.

Never in the history of the country has there been such a shortage of skilled and unskilled labor as today. On the other hand there never has been a time when there was such a demand for labor of all kinds. It is the duty of all who have to do with labor to see that none of the possible supply is wasted.

If a person applies for a position for which he is not suited, he should be sent to some central point where he can be listed and his labor utilized. Otherwise, he will wander from establishment to establishment without any of them being able to utilize his efforts. In the meantime, days of effective labor have been lost. It is just as easy to refer all who cannot be used to such an agency as it is to take and destroy applications, or to tell them that there is no work. It is today a patriotic duty to prevent labor waste.

Perhaps the gravest question that confronts the employment man in the small plant today is the fact that he is unable to select the kind of labor which he desires—hence, much more now depends on careful training and development of employees than previously.

Editorials and Comment

Reorganization of the Labor Department

THE leading article in this issue, written by Secretary of Labor, Hon. William B. Wilson, is worthy of the most careful study on the part of all industrial executives and engineers. Although the plan he outlines is aimed at war conditions and war problems, there is not the least shadow of a doubt but that the machinery now set up and the functions taken over will persist after the war and become a regular part of our industrial procedure.

The chart on page 267 shows that seven administrative sections have been created to deal with various phases of the war labor problem. With perhaps a single exception—that of training personnel for the Labor Department itself—all of the functions established will need to be exercised during the days of peace. Several of them have already existed in a small way, and others have been exercised for various branches of the government by especially appointed agencies since the outbreak of war.

The real purpose of President Wilson's executive order of January 8, 1918, was to bring about coördination of all of the various agencies that were dealing with war labor problems. It was but natural that he should concentrate all of this work in the Department of Labor and make the Secretary of Labor responsible therefor. In fact this act of the President stands out as a conspicuous one in the process of coördinating and centralizing our national activities. The great purpose in this case is the needful one of setting up a peaceful process whereby industrial grievances can be speedily redressed.

The difficulties of the work are evidently appreciated by Secretary Wilson for he has established two consulting Board. The one, known as the Planning Board, is to lay down broad principles of policy in regard to the relations of employers and employees during the period of war. Both employers' and employees' organizations are represented on this board by a number of eminent men. The interests of the public at large are to be looked after by two distinguished citizens: Ex-President William H. Taft and Mr. Frank P. Walsh. The other board is advisory in nature, and is to deal more particularly with matters relating to the organization and administration of the war labor program of the Department.

Up to the present time it has been the consistent policy of the Department of Labor not to interfere in industrial disputes, although from the first it has had a group of expert conciliators. But the services of these men have never been offered until one or the other side of the labor controversy made a request for them to act. It has been feared that the efforts of these men might tend to antagonize either one or the other side in the controversy, or create false hopes of a more satisfactory settlement, and thereby delay the getting together that must come before such grievances can be adjusted.

It is gratifying also to realize that the number of cases submitted for redress has been steadily growing as the work has become better known. Following this reorganization there should be a much more widespread appeal to the good offices of the Department.

The great object to be arrived at, at the present time, is to prevent industrial disturbances, rather than to adjust them after they have occurred. We need to keep every man and woman at work in industry and use nothing but peaceful means to straighten out differences.

It is gratifying to appreciate that there have been fewer strikes and labor troubles of a serious nature in this country during the first year of war than in any immediate preceding year. It is also worth a moment's reflection that the number of labor hours lost on two holidays, the Fourth of July and Christmas, 1917, was greater than all of the labor hours lost through all of the strikes in industry during the year.

Non-essential Industry

ONE of the most far-sighted observations made by a prominent American who visited Germany shortly before our declaration of war was to the effect that for the German people the condition of war is *normal*. Therefrom comes a great deal of German's success and holding-out power in the present struggle. As soon as an individual, or group of people, or nation becomes normal in a new environment, he or they can continue to live and work indefinitely under those conditions. Futhermore, they can then exert their full power toward whatever object is before them. As the German people has become normalized to war conditions they can exert their full industrial and military strength, and keep on with that exertion for a long period, perhaps indefinitely subject only to military defeat.

Just contrast that situation with our own. With us a condition of war is abnormal. Hardly any of its processes have become a matter of course to our people. Our usual methods of life have been changed and we are not yet adjusted to the new. Yet one of the things we must do if we are to exert our full national strength is to take war conditions as normal conditions until the day of victory and final peace comes.

Our Allies are much more normalized to war than we are. One proof of this is the fact that the food consumption of France and England has decreased some 30 per cent. since the outbreak of the war, while with us food consumption increased 10 per cent. last year. These widely divergent percentages indicate in some degree the proportion of national effort which is being made by our Allies and by ourselves. To be sure, the normalized process has been going on with them for some three and a half years, while with us it has only exerted influence for about one year.

* * * *

We are all moved by the appeals of the French and British statesmen to hurry up our military and industrial preparations and speed forward the supplies and food that we are to send across the Atlantic. These calls for help can only be properly met after we take this war more seriously to heart, and realize the extent to which we are facing a life and death struggle where the fate of this great nation is hanging upon our industrial and military efforts.

From our Allies comes the appeal for fighting men, for technically trained men, for food, for ships, for raw material for munition manufacture, for railway supplies, for rolling stock, for fuel. To supply each one of these items makes a drain upon our economic and industrial resources.

What should be our attitude toward non-essential industries?

This question is coming forward insistently at just this time and there is much divergence of opinion in its discussion.

Manufacturers who own and manage industries that are coming to be generally classed as non-essentials, are pointing out that their businesses must not be allowed to lapse or be disturbed for they will be needed at the close of the war, and the expense of rebuilding and replacing them will be tremendous. These men are asking for government contracts of one kind or another to keep their plants going, or else are asking for raw materials and fuel to keep up some measure of their regular business. Along with these requests they point out that there is every good reason why practically every industry should be kept going and none be allowed to lapse. In other words, they take the position that there is really no non-essential industry if we will but consider the activity of the country as a whole and our export trade, and look forward to the days of peace. Some of the arguments presented are these: The manufacturer of cheap jewelry says that his industry should be kept up as his product is one of our regular exports to the western coast of South America, and is one of the commodities used for paying for Chilean nitrate. He says that in spite of the war Chilean, Peruvian and Bolivian women desire jewelry. One of the great sources of supply is the United States.

The candy maker says that his product is a food, one that is highly prized by our soldiers and sailors as well as by a large part of the civilian population. So candy making is not a non-essential industry.

The chewing gum manufacturer says that the chewing of gum relieves nervous tension and that in these disturbed days of war people need his gum more than ever.

The silk producer claims that the wearing of silk should be promoted and increased in order to release wool and cotton for military needs. This may be a very practical viewpoint, but should not the amount of silk permitted for a gown be brought down to a minimum? To cite only one other instance, the manufacturers of musical instruments claim that their products are needed more than ever to assist in keeping up the spirits of the people, and that many homes can now procure a piano, phonograph, or other instrument because of the increased earnings of the family due to the war prices for labor.

The above are typical arguments urged as reasons for maintaining so-called non-essential industries.

* * * *

But this is the question. Have we sufficient industrial strength to support all of these industries and at the same time produce everything needful for ourselves and our Allies in the prosecution of the war? Can we continue all or any part of the non-essential industries and plant the increased acreage of wheat that is necessary to produce the cereal food for ourselves and our Allies next winter? Can we keep all of the non-essential industries going and turn out the ships that we must have to transport our troops to France, keep them supplied with food, clothing and fighting material and feed and munition our Allies? Can we keep all of these industries going and at the same time produce the necessary equipment and find the necessary labor to improve our railroads and outfit them with new rolling stock? Can we mine and transport all the fuel needed next winter, and still maintain these non-essential industries?

Each one of these questions is searching.

There can be but one answer. If we can produce everything needful for the prosecution of the war and keep every industry going, all well and good. We should do it. But if a choice must be made, if we must decide between food, munitions, fuel, ships and railroad material, and jewelry, chewing gum, silks, musical instruments, candy and similar products, there can be but one possible answer.

It is very easy to understand the attitude and situation of the man who has built up a big business producing the things which today are being classed as non-essential. Such a man is entitled to our sympathy. But he is not the only one who is suffering, and the curtailment of his business is a pretty small price to pay for upholding the nation alongside of the great sacrifice of the young men who are entering our army and navy, thousands of whom will be buried in the soil of France before even this year ends.

So while there is a time when true sentiment is needed, it is no time for sentimentality. The seriousness of the situation is such that many non-essentials must go. The drowning man hastens to divest himself of everything that tends to drag him under. So with us, we must resolutely push aside those activities that are not helping to win the war until the time comes when we are exerting all of the industrial and economic power that we need to reach forward to victory.

Handling and Conveying Machinery

A MAJOR, illustrated article in this issue shows with much illuminating detail methods used in Great Britain for handling shells during the processes of manufacture. The development of these devices has gone much further there than here. The reason is not far to seek. The entrance of hundreds of thousands of British women into machine shops has made it necessary to provide hoisting, lowering and conveying machinery in a way that has never been needed here even with our higher priced labor. In this issue on page 280 Mrs. Harry E. Heustis points out that machines, particularly machine tools, have always been designed for men, and that there must be modifications when women are employed. She tells us what we should have recognized at once, that a woman's height is shorter than man's; that her reach is less; that her muscular strength is not so great. So there must be provided means to adapt machine operation to woman's physical powers, and above all lifting and tugging must be prevented.

A glance at Mr. George F. Zimmer's article on page 269 gives an idea of some of the ingenious devices that have been developed for handling shells from the medium sized 18-pounders up to the 12 and 15-inch. Full advantage has been taken of the cylindrical shape of the shell, which permits of easy rolling, and also of the comparatively short length which allows of easy sliding. With well designed devices but little physical effort is needed to move shells along tracks or runways at about the level of the machine. Some of these devices are completely automatic in their action.

Other groups of devices are those which elevate or lower, and many of these are automatic, having been modeled after pre-war installations for conveying bulky, heavy objects like barrels of sugar, bags of cement or coffee, and the like.

Still another group of devices are the hand-moved and power-driven industrial trucks, particularly of the lifting type, which have grown in appreciation in American factories during the last five years.

A number of these devices have their origin, so far as principle and early development is concerned, in the factories of the United States, but application has gone forward rapidly in England due to the special needs of producing a continuous flow of war munitions and the employment of women.

Emphasis is given in the article to the fact that a large percentage of the time actually consumed in producing a shell is taken up in moving it from machine to machine, or process to process. So these devices for handling and conveying play a very important part in the continuous, rapid production of shells. They must occupy a similar place of importance in American munition plants. Our manufacturers cannot be counseled too strongly to look to the details of this class of machinery, especially before they begin to employ women in large numbers, and especially as the continual supply of munitions—the thin, rapidly flowing stream—is one that is the most effective in the long run.

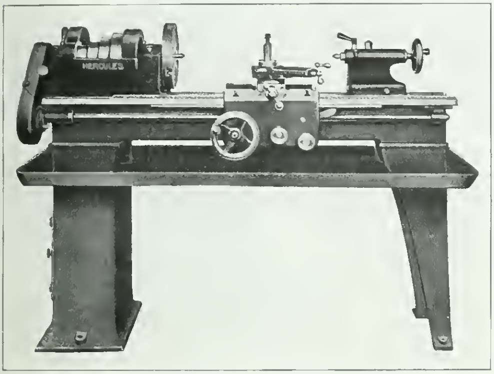
Factory Equipment News

The Latest Labor-Saving Machinery

Hercules 12-inch Lathe

THE Hercules 12-inch, screw-cutting engine lathe has been designed for the tool room, experimental department and for light, accurate manufacturing work. In general design it follows standard construction.

The bed is a closely ribbed, box-type section provided with two Vees, one to guide the carriage, the other, at a lower level, to guide the headstock and tailstock. The material in the bed is semi-steel.



HERCULES 12-INCH LATHE

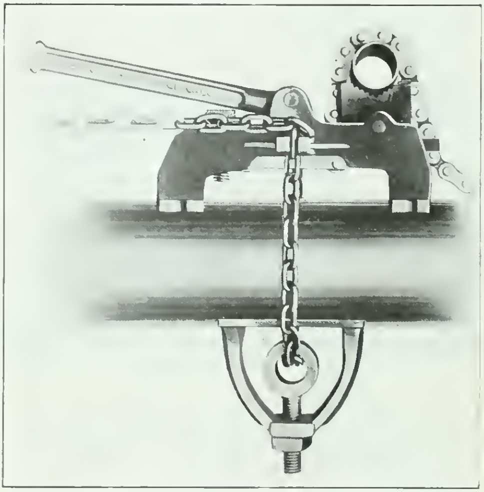
The headstock casting is designed to give a rigid support to both front and rear bearings. The cone is finished both inside and out, and is dynamically balanced. The spindle is hollow bored, made from a 50- to 60-point carbon crucible steel forging and is ground to size. The bearings are lubricated by a chain oiling system.

The tailstock is of the extension barrel type to provide clearance over the carriage bridge for turning short work. It has a side adjustment for taper turning.

The carriage is gibbed both front and back and has a locking device to clamp it to the bed when using the cross feed. The cross-feed screw is provided with a micrometer collar. The feeds are positively driven by change gears through a splined lead screw, worm and gear, and then through spur gears to the rack through a friction. The range of threads that can be cut is from 3 to 72 per inch. The range of feed per inch is 1/10 times the threads. The spindle speeds are 808, 500, 326, 214, 95, 59, 38 and 25 r.p.m. This machine is manufactured by the Himoff Machine Company, New York City.

"Chaingrip" Pipe Vise

A PIPE vise marketed under the name of "Chaingrip" is shown in the accompanying half tone. The base support is in the form of an inverted V having bolt lug feet by means of which the vise can be permanently bolted in any desired position. This design permits the vise to conform to a round, square or flat surface. An opposing clamp support has an eye bolt with a heavy nut and a chain passing through the eye. The base of this support is similar in shape to that of the base of the vise; the manner in which the chain links to the vise base, and is put under tension by the eye bolt of the support is plainly seen from the illustration.



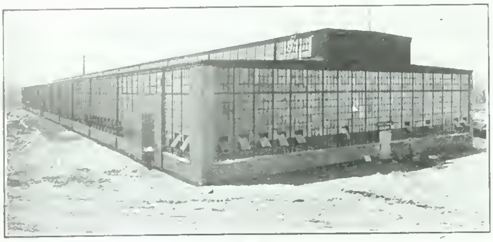
"CHAINGRIP" PIPE VISE

The pipe gripping chain of the vise is a closed link steel chain arranged to lock the pipe against a double set of steel pipe jaws by a single movement of the vise handle. The "Chaingrip" vise is marketed by the Gerolo Manufacturing Company, Old Colony Building, Chicago, Ill.

Standardized Factory Buildings

CONSIDERING the factory building as the largest tool used in construction it is but natural that some attempt should be made to standardize it for various kinds of factory use. Such standardization has been carried to a high degree by The Austin Company, Cleveland, Ohio. Obviously the reduplication of a set design would lower the cost, uphold predetermined quality and quicken the process of erection of a factory building. So the Austin Company has adopted nine types of various designs varying in width, length and number of stories covering most factory needs.

The standardized types are stripped of non-essentials and the construction is simplified to the limit. For this reason structural steel and other materials usually ordered after a building contract is signed are fabricated in advance and carried in stock ready for buildings when they are ordered. A system of storehousing and branch office service permits of the use of fabricating capacity in various sections of the United States.



AN AUSTIN STANDARD BUILDING

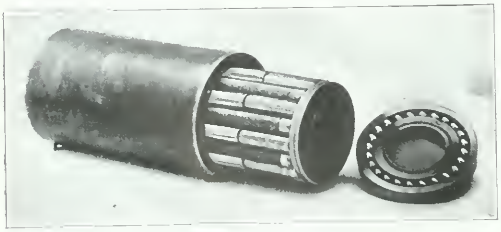
One of the advantages of this type of construction is the speed of erection. Three of the types of Austin standard buildings can be completed in 30 working days each, others in 60 days, and the largest in slightly longer periods.

INTERIOR OF AN AUSTIN BUILDING

The accompanying illustrations show an external and internal view of two buildings recently erected. Since the outbreak of war this company has completed approximately 130 structures for war production, including foundries, steel works; machinery building plants for submarine chasers, airplanes, tractors and munitions; and mills for producing chemicals and textiles.

Planetary Roller Bearing

THE Planetary Roller Bearing Company, Chicago, Illinois, is placing on the market a roller bearing for use on line shafting and machinery in general including automobiles and tractors. This bearing is called the Planetary Roller Bearing because of its principal feature of design.

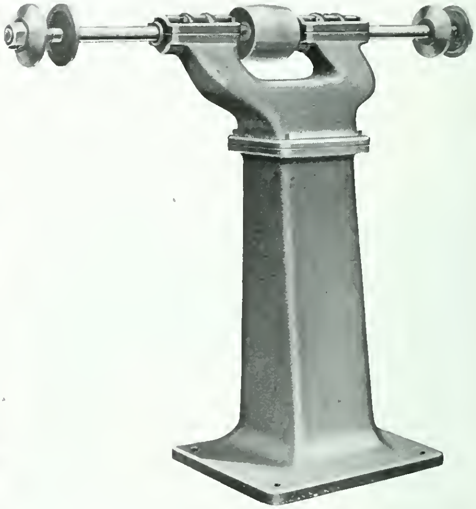


PLANETARY ROLLER BEARING

In construction it consists of a series of plain rollers fitted end to end and arranged to revolve within a casing or box and bearing upon the shaft, spindle or axle. This series of bearing rolls is held in alignment by alternating or separating rolls of a slightly less diameter. The length of the idler roll is practically the combined length of the series of bearing rolls. The bearing rolls and their separating members roll upon each other's surface thereby avoiding sliding contact. This elimination of sliding friction reduces the consumption of lubricant to a minimum.

St. Louis Polishing Machine

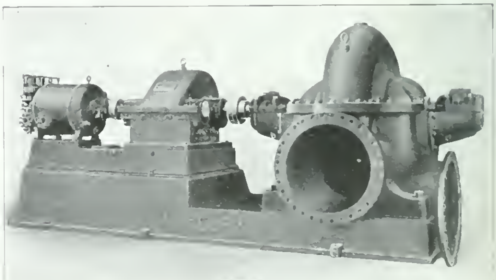
THE No. 10 size of the St. Louis polishing machine marketed by the St. Louis Machine Tool Company, St. Louis, Missouri, is shown herewith. Its design follows standardized lines. The arbor diameter in the collars is $1\frac{1}{4}$ inches, in the bearings $1\frac{1}{2}$ inches; distance between wheels 44 inches; length of bearings 7 inches. The bearings are milled and fitted in keeping with engine lathe practice; they have large oiled cellars and are chain-oiling.



NO. 10 ST. LOUIS POLISHING MACHINE

End Suction Centrifugal Pump

THE feature of interest in the centrifugal pump illustrated herewith is the position of the suction opening; this is directly beneath and parallel with the end bearing. This arrangement makes it possible to place a pumping unit in a room of small ground area, considerably smaller than where the suction end is opposite the outlet end. In some cases it also facilitates the mak-



END SUCTION CENTRIFUGAL PUMP

ing of pipe connections, sometimes saving elbows and reducing the length of piping. This new design is manufactured by the Wheeler Condenser & Engineering Company, Carteret, N. J.

Milling Machine Dynamometer

A dynamometer specially designed for use on the milling machine has been developed by Mr. R. Poliakoff, Room 711, Flatiron Building, New York City. The general design of the instrument is shown in the accompanying illustrations, Figures 1 and 2. It is adapted to measure the pressure exerted in milling cuts resolved into three components, each one at right angles to the other two. In this respect it goes much farther than the usual machine-tool dynamometer.

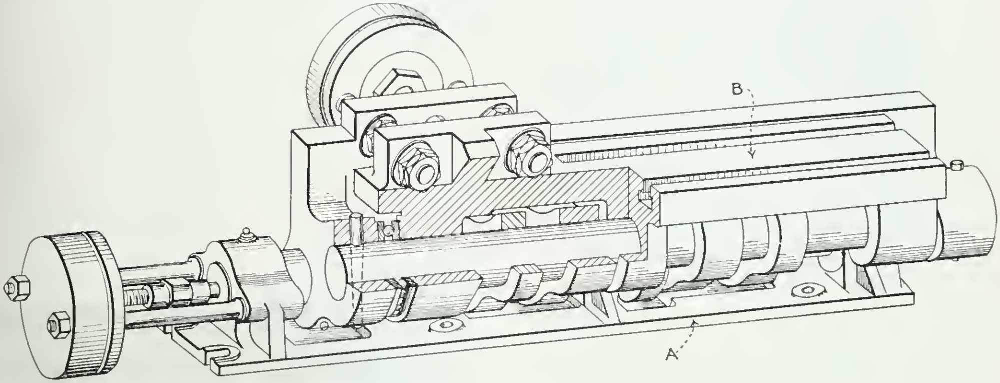


FIG. 1 MACHINE TOOL DYNAMOMETER—GENERAL DESIGN

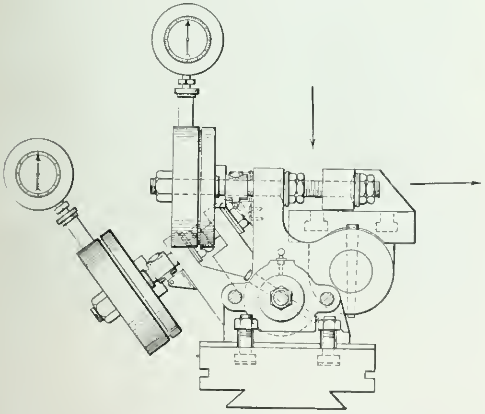


FIG. 2—END ELEVATION OF DYNAMOMETER

Its operation is substantially as follows: The instrument is mounted on a foundation plate *A* which rests upon the table of the milling machine and is attached thereto by bolts in the usual manner. The work to be milled is placed on the auxiliary table *B* and made fast thereto. The work and milling cutter are then brought together and the cut started.

The resulting pressures exerted on the work upon the table *B* may be resolved into three components.

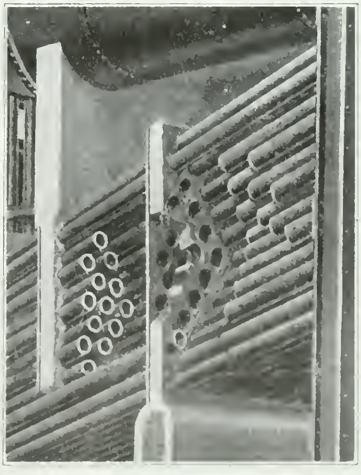
Referring to Figure 2, the horizontal arrow pointing in the right-hand direction indicates the direction of one of these components. The vertical arrow pointing downwardly toward the table indicates a second component. The direction of the third is parallel with the surface of the table and at right angles to the other two. So the resultant pressure can be split up into three components, and each is registered on a separate gage of the instrument. Two of these gages are shown in Figure 2.

It is unnecessary to describe in detail the mechanism by means of which the pressure is transmitted from the table to the various hydraulic gages. It is sufficient to say that the pressure causes a flow of liquid to register accurately upon the gages the amount of the pressure in each of the three directions.

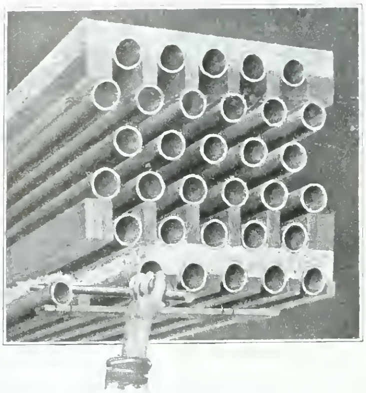
The instrument is adapted to determine the pressure required for various milling operations, and thereby assist in determining the strength of the parts of milling machines or to analyze the action of various types of cutters or the degree of difficulty for cutting the various materials.

Plastic Refractory for Boiler Baffles

THE accompanying illustrations show a jointless baffle made from a refractory mixture manufactured by the Betson Plastic Fire Brick Company, Rome, New York, and marketed under the trade name of "Plastic Fire Brick." This material was originally introduced for lining boiler furnaces, and is compounded of refractory materials so prepared as practically to eliminate



PLASTIC FIREBRICK BAFFLES IN B. & W. VERTICAL HEADER BOILER expansion and contraction with changes in temperature. The material is shipped in barrels in a moist plastic condition ready for use. In forming a cross baffle for a water tube boiler of the B. & W. type, the ordinary cast-iron baffle plate is used as one side of the mold, while the other side is made by thrusting slats in through the diagonals between the tubes, as shown. The plastic material is then poked down through the diagonals to fill the space between the cast iron baffle plate and these slats. It is sufficiently plastic so that it can be forced out sidewise around the tubes, fitting the latter snugly.



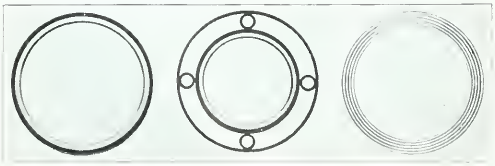
HOW MATERIAL IS PACKED IN TO FORM BAFFLES IN WATER TUBE BOILERS

When this work has been completed, the boiler is fired up slowly, the criss-cross of slats burns out, and the plastic material is dried and vitrified in place. This operation occupies only a few hours, after which full load may be put on the boiler. Inasmuch as the boiler comes up to full steam pressure before the material is thoroughly set, the expansion of the metal pushes away the soft material to the position which it should occupy when the boiler is hot, and while the boiler will draw away from the material in cooling, the baffles will fit tightly when the boiler is under steam.

In forming a longitudinal baffle, blocks of wood are placed in between the tubes, above and below the space which it is desired that the baffle shall occupy, thus confining the plastic material, which is shoved in from the side in the case of baffles in the middle of the tube bank, or from underneath or overhead, in the case of the baffles at the bottom or top of the tube bank.

Sarco Metallic Gasket

THE Sarco Company, Inc., New York City, N. Y., has just placed on the market a line of metal gaskets. There are three forms of which the simplest is for cases where the coupling surfaces are relatively narrow.



SARCO METALLIC GASKETS

For use on flange connections, where the surface is broader, the gasket element is surrounded by a ring, the outside diameter of which is a trifle less than the diameter of the circle on which the inner edges of the bolt holes lie and the bolts when slipped in place thus center the gasket.

For use with superheated steam the gasket is made of concentric copper rings. If the gasket is to be used with fluids which would injure the copper ring, special gaskets are available in which this ring is surrounded by one of lead to form an effective seal against corrosive agents. Sarco metallic gaskets are regularly made for pipe size from 1 to 20-inch inclusive. The same type of construction is applied to non-circular gaskets, such as are required for manholes, digester doors, valve chests, and the like.

Space Heater Unit

A METHOD of heating enclosed and inaccessible places or remote corners such as crane cabs, valve, pump and meter houses, and similar places in industrial plants, is provided by means of steel jacketed electric heater units such as is illustrated herewith. The unit shown has a 500 watts capacity and can be connected to any a.c. or d.c. circuit where the voltage does not exceed 250 volts. As many units as are required can be connected in the same way that electric lamps are placed, either singly or in groups, depending upon the amount of heat required.

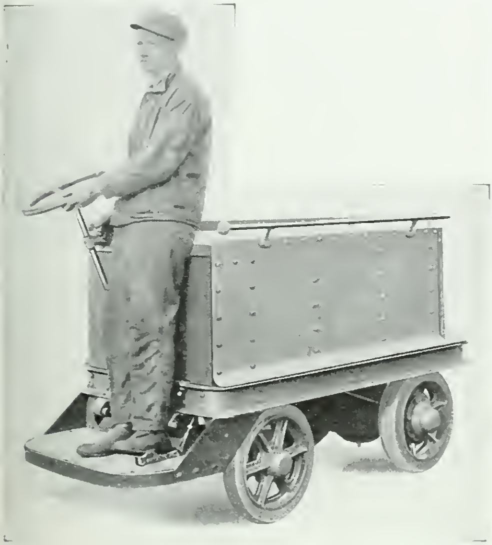
CUTLER-HAMMER SPACE HEATER UNIT

The units are flat with the following dimensions, 3/18 x 1½ x 23¾ inches. All of the parts are enclosed and no porcelain, cement, asbestos or molded insulation material is used. Insulated eyelet holes permit the use of ordinary screws for mounting; terminal connectors are provided at each end. In mounting, space is provided between units and between unit and the surface on which it is mounted to allow for a good circulation of air.

These units are a product of the Cutler-Hammer Mfg. Company, Milwaukee, Wisconsin.

Model C Lansing Truck

THE accompanying illustration shows the Model C type of electric industrial tractor built by the Lansing Company, Lansing, Michigan. The general lines of construction are plainly shown. The operator's platform and seat are so placed that he may either stand or sit and drive the machine either forward or backward with equally sure control. When facing forward the steering wheel and controller are at the operator's right. When the lever steer is used the lever is at the right and the controller handle is at the left. The brake pedal is under the left foot.



MODEL C LANSING TRUCK

The material used in the construction is structural steel, drop forgings, steel and bronze castings. All parts are made with jigs and templets. Wearing surfaces are hardened and ground or bronze bushed.

The driving axle consists of a steel casting enclosing the drive worm and gear, the differential and the bearings in an oil chamber. The differential is of the bevel gear type with six gears. The gears are of high carbon steel in the smaller tractor, and of nickel steel in the larger. The front axle is of cast steel of standard automobile design, with steering knuckles having hardened and ground knuckle pins in bronze bushings.

The main frame is a four-inch channel in one piece bent to form. Leaf springs are mounted on the front axle ensuring flexibility.

The brakes are external acting steel bands lined with raybestos. They are set by the pedal and a latch holds them set or permits of their being used in coasting by a slight shifting of the operator's foot.

The motor controller and brakes interlock in such a way that the brakes can only be set when the controller is in neutral. When the brakes are set the controller is locked although with controller in neutral the brakes may be released and operated freely for coasting.

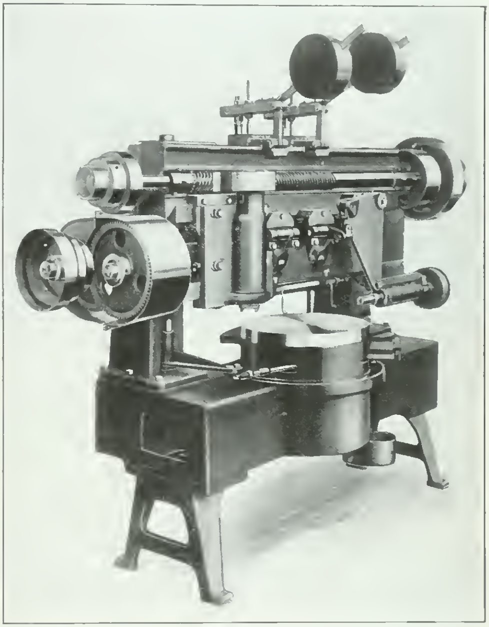
A battery compartment opens at the end and the battery is mounted in a wooden box on rollers.

All moving or wearing parts, as wheel hubs, knuckle pins, steering gears, etc., are provided with oil cups conveniently located.

The general specifications are as follows: Capacity of trailer load 4,000 to 5,000 pounds; speed empty, 7 to 8 miles per hour; speed with load, 4 to 5 miles per hour; weight with battery, 2,500 pounds; length, 6 feet 8 inches; width, 3 feet; height, 4 feet; length of wheel base, 3 feet; tread of wheels, 27 inches; turning radius, 5 feet 6 inches.

Special Milling and Drilling Machine

A SPECIAL machine designed primarily for the milling and drilling of steering knuckles for automobiles is illustrated herewith. It is intended to machine at one setting the surfaces of the knuckles and also to drill the holes. It is continuous in its operation, that is, when one piece is being milled and drilled the operator is inserting another piece on the revolving table and getting it ready so that when the first piece is finished the second swings into place and the cutting commences. The piece just finished is then removed, another put in place and the operation is continued.



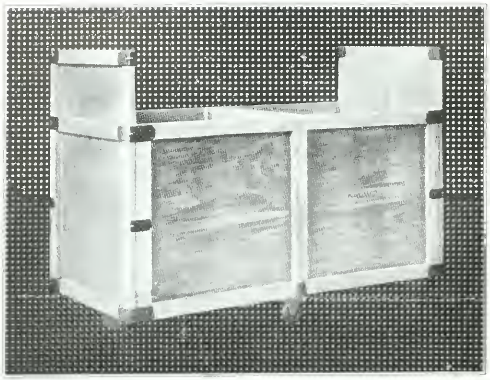
MOLINE MILLING AND DRILLING MACHINE

This type of machine is adaptable for other parts and different work than that for which it was originally designed. The travel of the spindle can be increased or decreased within a considerable range.

The general specifications of the machine are: Floor space 3 x 8 feet; distance from floor to top of table 36 inches; shipping weight about 5,900 pounds. The machine has four spindles, one for milling and three for drilling. One drilling spindle is driven by a belt directly from the driving shaft, the others are driven by spiral gears. The spindle feed is from a cam, and the throw can be varied to suit the work. The milling spindle has a large taper bearing at the lower end to take up wear. All of the fast running bearings are bronze bushed. The work table is 22 inches in diameter and revolves automatically one-sixth of a revolution after the tools are withdrawn, thus bringing the work in position for the next operation. A $5\frac{1}{2}$ horse power motor is necessary to drive. This machine is a product of the Moline Machinery Company, Moline, Illinois.

"Indestructo" Trucks

An industrial truck design along the lines of "Indestructo" trunk construction has just been placed on the market. The two prominent features are: first, three-ply laminated panels made from hardwood lumber glued with a special process developed in trunk making and, second, especially designed hardware including ribbed corner pieces to give rigidity and permanent strength.

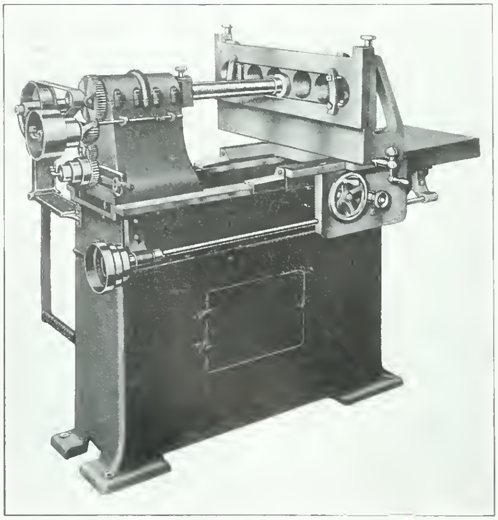


"INDESTRUCTO" TRUCK

The illustration shows one of these trucks and the line is made by the National Veneer Products Company, Mishawaka, Indiana.

Internal Grinder

A NEW type of internal grinder, or regrinder, has just been placed on the market by the B. L. Schmidt Company, Davenport, Iowa. The machine is illustrated in the accompanying halftone.



B. L. SCHMIDT CO. INTERNAL GRINDER

Features of construction include a boxed section bed with wide flat bearing surfaces for the carriage. The headstock carries a spindle 6 inches in diameter and 12½ inches long. The carriage is gibbed both front and back and bears on the bed throughout its entire length. The cross slide of the carriage has a bearing surface 22 inches long by 8 inches wide. The carriage is reversed by means of a pair of tumbler gears operated from a gear on the driving pulley. The feed rod carries a three-step cone giving three changes of speed for the movement of the carriage. The angle plate on the carriage has a separate front plate with a device by means of which the angle plate may be raised and lowered. This construction facilitates the centering of work.

The counter shaft attached to the bed of the machine is fitted with ballbearings. The range of grinding is from 2½ to 8 inches in diameter, and up to 15 inches in length.

Coal Conservation in Industrial Plants

By W. M. Graff

Vice-President, Graves Engineering Company

THE difficulty of obtaining coal should bring to the attention of executives the advisability of investigating their power plant conditions and the waste of steam throughout the works. Owing to constant association, wasteful conditions often escape attention or are considered unimportant. Few realize that losses may be continuous throughout the 24 hours of the day.

Improvements can be made in the boiler room by means of detailed instructions to the firemen, and by better maintenance of the boiler and furnace walls, but the supervision should not stop there. It should follow all the steam pipes to their end, and should include the uses made of condensed steam.

As an example of what can be done in curtailing losses, the following table is presented to show what has been done in a plant of 600 h.p. rating.

The comparisons given are in boiler horse-power. There was more than a corresponding saving in coal, due to a substantial increase in boiler-room efficiency, but the comparison is not so clear, because of variations in the quality of the coal burned during the period under supervision. However, during this period of supervision, the saving in coal was equivalent to three times the cost of the equipment used plus the engineering counsel.

The steam generated in the six-hour period between 6 a. m. and noon each day, represents the useful work plus the distribution losses, while the steam generated in the six-hour period between midnight and 6 a. m. each day, represents the distribution losses only. The difference represents the useful work, or net load.

AVERAGE HORSEPOWER DEVELOPED BY BOILERS DURING TWO FIVE-MONTH PERIODS.

	Previous to supervision 1915-1916			During supervision 1916-1917		
Month	Total load	Distribution losses	Net load, average horse-power	Total load	Distribution losses	Net load, average horse-power
October .. .	450	347	103	412	180	232
November ..	576	439	137	495	241	254
December ..	651	504	147	636	380	256
January	647	511	136	638	435	203
February ...	686	503	183	690	457	233
Total	3,010	2,304	706	2,871	1,693	1,178
Average ...	602	461	141	574	339	235
Percentages.	100	76	24	100	59	41

It will be noted that the net load on the boilers was increased from 24 per cent. of the total load to 41 per cent.; that is, the efficiency of distribution and utilization was increased 71 per cent.

The plant was working on war orders at more than full time. Because of increased boiler efficiency in producing steam, and a decrease in the losses in the use of steam, and in spite of a 67 per cent. increase in net load, the installation of additional boiler capacity was avoided.

Personal and Business Items

With the first of the year the Economy Engineering Company, Chicago, Illinois, has opened its own office at 85 Murray Street, New York City, with Mr. A. D. White in charge.

* * * * *

The Detroit Steel Products Company, Detroit, Michigan, has recently put out a folder giving details of construction and operation of the Fenestra straight line sash operator.

* * * * *

The Permutit Company, 30 East 42nd Street, New York, N. Y., manufacturers of water softening and water rectification apparatus, announces its removal to 440 Fourth Avenue, New York, N. Y.

* * * * *

The Bacharach Industrial Instrument Company of Pittsburgh, Pennsylvania, has issued Catalogue "E" describing Hydro Gas Meters. It contains a review of methods employed for measuring gases, such as impact and pitot tubes, orifices, nozzles, venturi tubes, etc.

* * * * *

Mr. Daniel Bloomfield, who is well known to readers of INDUSTRIAL MANAGEMENT, is now head of the Industrial Service Department, Division of General Service of the Emergency Fleet Corporation of the United States Shipping Board.

* * * * *

The Farnsworth Company, Conshohocken, Pennsylvania, has recently brought out a catalog in the form of 24 sheets describing the twelve types of machines for handling condensation built by the firm. Each sheet is illustrated by an outline drawing showing a particular machine or its application.

* * * * *

Mr. James A. Harris, Jr., for many years advertising manager of the White Company, has resigned to accept a commission as Captain in the Quartermaster Corps. He has been succeeded by Mr. Millard H. Newton, who has been connected with the company's advertising department for the past five years.

* * * * *

Bulletin No. 7, describing the Chapman Floating Agitator has just been issued by the Chapman Engineering Company, Mt. Vernon, Ohio. The device can be applied to an ordinary hand-poked gas producer, converting it into a semi-mechanical machine, to increase the gasification and improving the quality and uniformity of the gas.

* * * * *

The Marion Machine, Foundry & Supply Company has taken over the entire business, good will, patterns, patents and drawings of the Planet Steam Specialty Company. The line of soot blowers for all kinds of water tube boilers made by the Planet Company will be still further developed and adapted to all types of boilers.

* * * * *

The Fellows Gear Shaper Company, Springfield, Vermont, has just brought out a fourth edition of its treatise "The Stub-Tooth Gear." This booklet has had an appreciative reception by engineers and designers in its previous editions for it deals in an interesting manner with the comparative advantages and efficiencies of the 14½-involute tooth and the 20-degree stub tooth for machine cut gears. This fourth edtion has been revised and enlarged.

* * * * *

Mr. C. H. Andrews, assistant to the president and chief engineer of the North Carolina Public Service Company, Greensboro, N. C., has been appointed general superintendent of the Southern Utilities Company, which corporation operates under management of The J. G. White Management Corporation, New York.

* * * * *

Mr. Frank J. Foley, Manager of the Mining Section of the Industrial Department, Westinghouse Electric & Manufacturing Company, has accepted a position as Manager of the Mining and Traction Department of the Edison Storage Battery Company, located at Orange, N. J.

* * * * *

The Trussed Concrete Steel Company, Youngstown, Ohio, has just put out a 24-page catalog illustrating and describing standardized shop structures built up from standard stock units. Industrial plants, warehouses, dining halls, factory hospitals and other buildings are shown, together with several pages of details of this type of standardized construction.

* * * * *

The Barrett Company, Buffalo, New York, has brought out an eight page folder devoted to the use of Barrett specification roofs for dye manufacturing plants. In particular the folder deals with roofs of the plant of the National Aniline & Chemical Company, Inc., one of the largest concerns in the American dye industry.

* * * * *

The Greenfield Tap and Die Corporation, Greenfield, Massachusetts, has issued a 24-page booklet on the Wells self-operating die. There is a profusion of illustrations and many of these are taken directly from the manufacture of munitions. In addition to describing the construction of the dies, and giving their advantages, there are several pages of details especially useful in ordering parts for renewal.

* * * * *

Mr. Uldric Thompson, formely Chief Engineer of the International Steel & Ordnance Corporation and who has up to recently been serving in an advisory capacity in equipping the new Artillery Ammunition Assembling plant at Rock Island Arsenal, has opened an office at 120 Broadway, New York, under the firm name of Uldric Thompson, Jr., Incorporated, Consulting and Industrial Engineers.

* * * * *

Mr. W. C. Austin, auditor of the Eastern Pennsylvania Railways Company, Pottsville, Pennsylvania, has been elected assistant secretary and assistant treasurer of that company. In 1917 Mr. Austin was transferred from the staff of traveling auditors of The J. G. White Management Corporation, New York, N. Y., to the accounting department of the Eastern Pennsylvania Railways Company, which company is being operated by The J. G. White Management Corporation.

* * * * *

A notable publication is the first anniversary portfolio of the Magnesia Association, under the title "Let 85% Magnesia Defend Your Steam." The book is an assemblage of all the educational publicity regarding this insulation which has been appearing continuously during 1917 in many technical papers, as well as the *Saturday Evening Post*. It is a series of presentations of the nature and applications of 85% Magnesia as insulation for steam pipes and boilers. A copy will be sent on request to the Secretary of the Magnesia Association of America, 702 Bulletin Building, Philadelphia, Pennsylvania.

EXPLANATORY NOTE—THE ENGINEERING INDEX

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cents. A denotes a price of 40 cents; B, 60 cents; C, 80 cents; D, $1.00; E, $1.20; F, $1.60. The letter N indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

Serial publications are indexed on the appearance of the first installment.

CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of INDUSTRIAL MANAGEMENT at 10 cents per month, or $1.00 a year; to non-subscribers, 25 cents per month, or $3.00 a year.

REFERENCE LIST OF PUBLICATIONS REGULARLY REVIEWED AND INDEXED

ARRANGED IN ORDER OF THEIR ABBREVIATIONS

A A Wkly	Aerial Age Weekly
AERA	AERA
Aeronts	Aeronautics
A I C E	Amer. Institute of Chemical Engineers
A I E E	Amer. Institute of Electrical Engineers
A I M E	Amer. Institute of Mining Engineers
A I Mt	Amer. Institute of Metals
Am Ec Rev	Amer. Economic Review
Am El-Chem Soc	Amer. Electro-Chemical Society
Am Fdymns Assn	Amer. Foundrymen's Association
Am Ir & Stl Inst	Amer. Iron & Steel Institute
Am Jl Pub Hh	Amer. Journal of Public Health
Am Jl Sci	Amer. Journal of Science
Am Mach	Amer. Machinist
Am Rd Blds Assn	Amer. Road Builders' Association
Am Ry Bdge & Bldg Assn	Amer. Railway Bridge & Building Association
Am Soc Ht & Vt Engrs	Amer. Society of Heat. & Vent. Engrs.
Am Soc Mar Dftn	Amer. Society of Marine Draftsmen
Am Soc Nav Engrs	Amer. Society of Naval Engineers
Am Soc Ref Engrs	Amer. Society of Refrig. Engineers
Am Soc Tes Mat	Amer. Society of Testing Materials
Am Wd Pres Assn	Amer. Wood Preserv. Association
Am Wr Wks Assn	Amer. Water Works Association
A R E A	Amer. Railway Engineering Association
A R M M A	Amer. Raliway Mas. Mech. Assn.
Arch For	Architectural Forum
Arch Rec	Architectural Record
A S C E	Amer. Society of Civil Engineers
A S M E	Amer. Society of Mechanical Engineers
Assn Eng Soc	Association of Engineering Societies
Assn I S E E	Association of Iron & Steel Elec. Engrs.
Aus Min Stan	Australian Mining Standard
Auto	Automobile
Autocar	Autocar
Bkn Engs Cb	Brooklyn Engineers' Club
Bos Soc C E	Boston Society of Civil Engineers
Br Rds & Sts	Better Roads and Streets
Brs Wld	Brass World
Bt Fe & Stl Pt	Blast Furnace & Steel Plant
Can Engr	Canadian Engineer
Can Min Jl	Canadian Mining Journal
Can Soc C. E.	Canadian Society of Civil Engineers
Cas Eng Mthly	Cassier's Engineering Monthly
Cen Ry Cb	Central Railway Club
Chem Eng & Min Rev	Chemical Engineering and Mining Review
C E Soc St P	Civil Engineers Society of St. Paul
Cl Age	Coal Age
Colly Gdn	Colliery Guardian
Col Sl Min Mag	Colorado School of Mines Magazine
Col Univ Qly	Columbia University Quarterly
Com Air Mag	Compressed Air Magazine
Com Vhle	Commercial Vehicle
Comwh Engr	Commonwealth Engineer
Concte	Concrete
Contg	Contracting
Contr	Contractor
Corn C E	Cornell Civil Engineer
Cr Min West Aust	Chamber of Mines of West Australia
E Cb Balt	Engineers' Club of Baltimore
E Cb Phila	Engineers' Club of Philadelphia
E Cb St L	Engineers' Club of St. Louis
Econ Geol	Economic Geology
Eff Soc Jl	Efficiency Society Journal
Elec Jl	Electric Journal
Elec'n	Electrician
Elec Rev	Electrical Review
Elec Rev Chi	Electrical Review, Chicago
Elec Ry Jl	Electric Railway Journal
Elec Wld	Electrical World
Eng & Con	Engineering and Contracting
Eng & Min Jl	Engineering and Mining Journal
Eng Ed	Engineering Education
Eng News Rec	Engineering News-Record
Engng	Engineering
Engr	Engineer
Eng Rv	Engineering Review
Engr Soc Penn	Engineers Society of Pennsylvania
Fkn Inst Jl	Franklin Institute Journal
Flying	Flying
Fndry	Foundry
Gen Elec Rev	General Electric Review
Ht & Vtg Mag	Heating and Ventilating Magazine
Ice & Refrig	Ice & Refrigeration
Ill Eng Soc	Illuminating Engineering Society
Imp Inst Bul	Bulletin of the Imperial Institute
Ind Man	Industrial Management
InstAut Engrs	Institute of Automobile Engineers
Inst Rad Engrs	Institute of Radio Engineers
Inst San Engrs	Institute of Sanitary Engineers
Instn C E	Institution of Civil Engineers
Instn E E	Institution of Electrical Engineers
Instn E & S Scot	Inst. of Engrs. & Shpbldrs. of Scot.
Instn Mun & Cnty Engrs	Inst. of Munic. & County Engrs.
Instn Mech Engrs	Institution of Mechanical Engineers
Inst Met	Journal of the Institute of Metals
Instn Min Engrs	Institution of Mining Engineers
Instn Min & Met	Institution of Mining & Metallurgy
Int Mar Eng	International Marine Engineering
Iron Age	Iron Age
Ir & Cl Trds Rev	Iron & Coal Trades Review
Iron Trd Rev	Iron Trade Review
Jl Actcy	Journal of Accountancy
Jl Geol	Journal of Geology
Jl Ind & Eng Chem	Journal of Indust. & Eng. Chemistry
La Eng Soc	Louisiana Engineering Society
La Nat	La Nature
L S Min Inst	Lake Superior Mining Institute
Machy	Machinery
Manr Assn Engs	Manchester Assn. of Engineers
Mfrs Rec	Manufacturers' Record
Mar Eng & Nav Arch	Marine Engineer & Naval Architect
Mar Rev	Marine Review
Mas Boil Mkrs Assn	Master Boiler Makers' Association
M C B A	Master Car Builders' Association
Mech Eng	Mechanical Engineering
Mech Wld	Mechanical World
Met & Chem Eng	Metallurgical & Chemical Engineering
Min Mag	Mining Magazine
Min & Met Soc Am	Mining & Metallurgical Soc. of Amer.
Min & Sci Pr	Mining & Scientific Press
Mun Eng	Municipal Engineering
Mun Engrs Jl	Municipal Engineers' Journal
Mun Jl	Municipal Journal
Nat Assn Corp Schls	National Assn. of Corporation Schools
Nat Engr	National Engineer
Nat Lime Mfrs Assn	National Lime Manufacturers' Association
Nature	Nature
N E C Instn	N-E Coast Institution
N E Rd Cb	New England Railroad Club
N E Wr Wks Assn	New England Water Works Assn.
N Y Dept Labor	New York State Dept. of Labor
N Y Rd Cb	New York Railroad Club
Per-Way Instn	Permanent-Way Institution
Phil Jl Sci	Philippine Journal of Science
Power	Power
Pwr Pt Eng	Power Plant Engineering
Prof Mem	Professional Memoirs
Quarry	Quarry
Roy Un Ser Instn	Royal United Service Institution
Ry Age Gaz	Railway Age Gazette
Ry Cb Pitts	Railway Club of Pittsburgh
Ry Engr	Railway Engineer
Ry Gaz	Railway Gazette
Ry & Loco Eng	Railway & Locomotive Engineering
Ry Mech Engr	Railway Mechanical Engineer
Ry Rev	Railway Review
Ry Sig Engr	Railway Signal Engineer
S A E	Society of Automobile Engineers
Schl Min Qly	School of Mines Quarterly
Sfty Eng	Safety Engineering
Sib Jl Eng	Sibley Journal of Engineering
So Af Inst Engrs	South African Instn. of Engineers
Soc Nav Arch & Mar Engr	Society of Naval Arch. & Mar. Engrs.
Soc Pro Sci Man	Soc. to Promote Sci. of Management
S & S W Ry Cb	Southern & Southwestern Railway Club
St L Ry Cb	St. Louis Railway Club
Stev Indic	Stevens Indicator
Stl & Iron	Steel & Iron
Surv'r	Surveyor & Municip. & County Engr.
Tel Engr	Telephone Engineer
Telephony	Telephony
Times Eng Supp	Times Engineering Supplement
Tmwy & Ry Wld	Tramway & Railway World
Univ Col Jl Eng	Univ. Colo. Journal of Engineering
Univ Ill	University of Illinois
Univ Kan	University of Kansas
Univ Minn	University of Minnesota
Univ Mo	University of Missouri
U S Bur Mines	U. S. Bureau of Mines
U S Bur Stds	U. S. Bureau of Standards
U S Dept Ag	U. S. Dept. of Agriculture
U S Geol Surv	U. S. Geological Survey
U S Nat Inst	U. S. Naval Institute
West Eng	Western Engineering
West Ry Cb	Western Railway Club
West Scot I & S Inst	West. Scotland Iron & Steel Inst.
West Soc Engrs	Western Society of Engineers
Wis Engr	Wisconsin Engineer
Worc Poly Inst Jl	Worcester Polytechnic Inst. Journal

The Engineering Index

The following pages form a *descriptive* index of the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world in the English, French, Dutch, Italian and Spanish languages, as far as possible on account of war.

The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the charter and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us. See the Explanatory Note given on the opposite page, where also the full titles of the principal journals indexed are given. This list is subject to change from time to time.

NOTE.—The Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

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INDUSTRIAL MANAGEMENT

EDUCATION

Apprentices

Report of the Committee on the Education of Apprentices. Also Report of Deputation to the Board of Education (84237 N). 30 pp. N E C Instn, Trans—Jan., 1918.

Apprenticeship

Apprentissage Et Préapprentissage (84598 C+D). M. A. Jully. 11,000 w. Bul Soc D'Encouragement Pour L'Industrie Nationale—Nov.-Dec., 1917. Apprenticeship and allied problems for workers.

Chemical Engineers

The Training and Work of the Chemical Engineer (84492 N). 58 pp. Faraday Soc, Trans—Dec., 1917. A general discussion introduced by Sir Robert Hadfield.

Corporation Schools

Activities of the National Association of Corporation Schools (84333 A). F. C. Henderschott, with discussion. 17 pp. N Y Rd Cb, Pro—Jan. 18, 1918. Training of apprentices.

Engineers

Present-Day Conditions Are Forcing the Engineer to Assume New Responsibilities (84006). C. R. Mann. 2000 w. Eng News-Rec—Jan 31, 1918. The needs of engineering education.

La Responsibilidad Profesional Del Ingeniere Y Del Arquitects (84580 D). M. Durrieu. 15000 w. Anales Sociedad Cientifica Argentina—July-Aug., 1917. Professional responsibilities of engineers.

Equipment Dept.

Equipment Department of a Railroad and Advantages It Offers to Young Men Who Want to Follow a Mechanical Line and Why Some Men Succeed in Life (84529 A). F. W. Brazier, with discussion. 20 pp. Cen Ry Cb, Pro—Jan., 1918.

Foundrymen

The School End of the Job in Training Foundrymen (84410 N). Clifford B. Connelley. 14 pp. A I Mt, Jl—Dec., 1917. The industrial trend of education and the effect upon the foundry industry.

Industrial Training

The Effect of the War on Engineering Education (84072 A). C. R. Mann. 1800 w. Met & Chem Eng—Feb. 1, 1918. Conclusions from extensive study.

Indexing

Some Suggestions on Filing and Indexing (84527 N). Frank E. Lathe. 8000 w. Can Min Inst, Trans—1917. The systems and their applications.

Japan

La Formation Des Ingénieurs Au Japon (84588 C+D). H. Chevalier. 4000 w. Bul Soc Ingénieurs Civils De France—May, 1917. Organization of Japanese engineers in relation to educational institutions. Courses of study recommended.

Research

Industrial Research (84395 N). Cecil H. Desch, with discussion. Plates. 20 pp. West Scot I & S Inst, Jl—Oct-Nov., 1917. Need of provision for industrial and technical research, especially referring to England.

Efficiency in Industrial Research (84277 A). Charles W. Hill. 3000 w. Met & Chem Eng—Feb. 15, 1918. Important factors in the operation of a research laboratory.

Social Training

A Plea for Definite Training for Social Responsibility by Means of Our Educational Institutions (84528 N). C. V. Corless. 15 pp. Can Min Inst, Trans 1917. Sociological problems discussed.

Trade Schools

Industrial Experience of Trade-School Girls in Massachusetts (84231 A). 263 pp. U S Dept Labor, No. 215—Oct., 1917. The problems; new questions involved; experience and wages; conclusions.

Training Workmen

Training of Workmen for Positions of Higher Responsibility (84348 D). F. C. Stanford. 11 pp. A I M E, Bul—Feb., 1918. Educational work to improve the human factor in industry.

War Effects

Effect of the War on Engineering Education (84218). C. R. Mann. 1800 w. Power—Feb. 12, 1918. Closer coöperation between school and industry.

FINANCE AND COSTS

British Industry

Wages and Profits in British Industry (84144 A). E. L. Good. 1500 w. Engr—Jan. 18, 1918. Labor's mistaken idea that capital takes a large share of the proceeds of industry and how to remove the delusion.

Cost Keeping

Cost Keeping and Construction Accounting (84435). G. Ed. Ross. Before N-W. Soc of Engrs. 3500 w. Eng & Con—Feb. 20, 1918. Outlines methods.

Cost of Keeping for Sand and Gravel Producers (84434). Halbert P. Gillette. Read before Nat. Assn. of Sand & Gravel Producers. 1400 w. Eng & Con—Feb. 20, 1918. Salient features of cost accounting and cost keeping.

Exports

A Japanese View of Railway Exports to the East (84441). 2500 w. Ry Age—Feb. 22, 1918. An interview with Akis Kasama of the railway commission.

Manufacturing

Manufacturing in Relation to Banking Research and Management (84327 A). Walter Rautenstrauch. Ill. 6000 w. E Cb Phila, Jl—Feb., 1918. Problems and difficulties, both social and economic.

Price Fixing

Various Price Fixing Plans Proposed (84140 A). 2500 w. Iron Age—Feb. 21, 1918. Latest steps toward centralization of purchases at Washington

Railroad Financing

Form to Be Taken by New Railroad Financing (84031). 3000 w. Ry Age—Feb. 1, 1918. Recommends that a bondholders' committee be established.

Shipyards

See Marine and Naval Engineering.

Valuation

The Value of Manufacturing Property (83986 A). Charles W. McKay. 2500 w. Machy—Feb., 1918. Appraisal methods and items that comprise the reproduction cost method.

Wages

Hearings Before Railroad Wage Commission (84156). 2000 w. Ry Age—Feb. 8, 1918. Nearly all classes of employees ask higher pay.

Hearings Before Railroad Wage Commission (84445). 4000 w. Ry Age—Feb. 22, 1918. Representatives of employers testimony.

Payment, Remuneration and Results (84322 N). C. H. Douglas. 1500 w. Beama Jl—Jan., 1918. Difficulties in industrial organization, outlining a plan which seems to meet requirements.

Wage-Payment Legislation in the United States (84334 A). Robert Gildersleeve Paterson. 178 pp. U S Dept Labor. No. 229—Dec., 1917. History of legislation and court decisions

MANAGEMENT

Card Index

Card Index Production System (83984 A). Lewis Johnson. 1200 w. Machy—Feb., 1918. Explains advantages of the system, giving sample cards.

Chemistry

Chemistry and Industrial Management (84565 A). Ellwood Hendrick. 2200 w. Ind Man—March, 1918. How chemists can assist industry by improving processes and eliminating waste.

Efficiency

The Question of Scientific Management (84235 N). James Richardson. 20 pp. Instn E & S Scot, Trans—Jan., 1918. Considers its application to conditions after the war; its aims are outlined and objections discussed.

Engineers

The Relation of Engineering to Industrial Management (84106 A). D. S. Kimball. 2000 w. A S M E, Jl—Feb., 1918. The service required of engineers and the training needed.

Forgings

Organizing to Produce Shell Forgings (84568 A). F. E. Merriam. Ills. 3500 w. Ind Man—March, 1918. Plans and methods that have proved successful.

Industrial Efficiency

Presidential Address (84236 N). Edwin L. Orde. 15 pp. N E C Instn, Trans—Jan., 1918. The recent work in England in meeting the requirements of war is reviewed, and the future needs.

Industrial Problems

Problems of Modern Industry (84253 A). W. L. Hichens. 2500 w. Ir & Cl Trds Rev—Jan. 25, 1918. Abstract of James Watt lecture before Greenock Philosophical Soc. Industry should be a national service in which private gain is subordinated to public good.

Labor

Mobilizing Intelligence on American Railways (84446). Norman Collyer. Abstract of address before the Pacific Ry. Club. 3000 w. Ry Age—Feb. 22, 1918. Labor turn-over problem.

Report of Committee XXII—On Economics of Railway Labor (84476 N). 72 pp. A R E A, Bul—Dec., 1917.

Under New Management—Judging Men (84573 A). Charles M. Horton. 3000 w. Ind Man—March, 1918. Efficiency methods' success depends on intelligent handling of labor.

Labor Problem

Social and Religious Organizations as Factors in the Labor Problem (84349 D). E. E. Bach. 10 pp. A I M E, Bul—Feb., 1918. Account of sociological work of the Ellsworth Collieries Co.

Labor Turnover

The Employment Manager and the Reduction of Labor Turnover (84347 D). Thomas T. Read. 13 pp. A I M E, Bul—Feb., 1918. Centralized living. Methods used. Results.

Management

Who Is Boss in Your Shop? (84577 B). M. L. Cooke. 7300 w. Bull-Taylor Society—Aug., 1917. Individual vs. group leadership in relation to democracy.

Operation Diagrams

See same heading under Mechanical Engineering, *Machine Works and Foundries.*

Organization

Developing the Community Interest (84110 A). Ills. 2000 w. Iron Age—Feb. 7, 1918. Organizations of the Burroughs Adding Machine Co. for relief and recreation.

Management Applied in Winchester Shops (84441 A). W. E. Freeland. Fourth article of a series. Ills. 2500 w. Iron Age—Feb. 21, 1918. New form of organization in cartridge departments and results.

Propaganda in Industrial Relations (84569 A). L. L. Warren. 1500 w. Ind Man—March, 1918. Relations of the human element in labor.

The Need for Organization in New Chemical Companies (84276 A). Frank Hemingway. 2000 w. Met & Chem Eng—Feb. 15, 1918. Address before Am Inst of Chem Engrs, dealing with problems of importance.

Purchasing

Organizing a Purchasing Department (84574 A). G. Sumner Small. 4500 w. Ind Man—March, 1918. Methods for successful purchasing discussed.

Route Sheets

Method of Making Route Charts and Route Sheets (84579 B). J. W. Carter. Ills. 2700 w. Bul-Taylor Society—Aug., 1917. Control and graphical charting of assembling operations.

Shop Gardening

Coöperative Shop Gardening (84613 A). Charles E. Hildreth. Ills. 700 w. Ind Man—March, 1918. A farm project for employees.

Shop Gardening as a War Measure (84614 A). Luther D. Burlingame. Ills. 3500 w. Ind Man—March, 1918. How factory employees can help increase the food supply.

Storage

Principles of Storage Applicable to Army Supplies (84578 B). H. W. Shelton. 7800 w. Bul-Taylor Society—Aug., 1917. Means of decreasing the cost of handling.

War Effects

A New Conception of Things: Capital, Labor, Government and the State (84321 N). J. M. Scott Maxwell. 1100 w. Beama Jl—Jan., 1918. Outlines views concerning the possibilities after the war of increasing the production of wealth.

War Industries

War Industries Being Brought Under Modern Engineering Control (84247). Mont Schuyler. 2000 w. Eng News-Rec—Feb. 14, 1918. Use of progress chart by Ordnance Department.

Women Workers

Increased Employment of Women in the Industries (83980 A). 2500 w. Machy—Feb., 1918. Problems involved in the substitution of women workers.

Our Experience With the Employment of Women (84097). David S. Earll. 1200 w. Am Mach—Feb. 7, 1918. Extract from a speech made at the New England Manufacturers' Conference. Great success.

Women in Engineering (84151 A). James Edgar. 1200 w. Mech Wld—Jan. 18, 1918. Effect of women's entrance into the workshops.

REGULATION

Control Bill

Progress of the Railroad Control Bill in Congress (84268). 6500 w. Ry Age—Feb. 15, 1918. Reported by Senate and House committees and discussion begun.

The Railroad Control Bill Is Reported (84163). 1800 w. Ry Age—Feb. 8, 1918. Amendments provide for termination of government control after fixed period.

The Railroad Control Bill in the Senate (84442). 9000 w. Ry Age—Feb. 22, 1918. Compensation, rate-making and period of control debated.

8-Hour Day

Report of Eight-Hour Day Commission (84029). 8500 w. Ry Age—Feb. 1, 1918. Wage increase resulting from Adamson law estimated at $61,000,000.

Farm Bureaus

The Relation of the Railroad to the Farmer (84162). George A. Cullen. 2000 w. Ry Age—Feb. 8, 1918. Far-reaching results from developments of farm bureaus in New York State.

Foreman

The Foreman's Position (84013 A). James Edgar. 1100 w. Mech Wld—Jan. 11, 1918. Requirements for success.

Metallic Minerals

Federal Control of Metallic Minerals (84337 D). 6000 w. A I M E, Bul—Feb., 1918. Text of proposed bill with abstract.

Missouri Laws

Missouri Tax Laws and Measures (84190). William F. Orthwein. 4000 w. Telephony—Feb. 9, 1918. Late laws affecting telephone companies.

Organization

Washington Making Preparations Against Industrial Unrest (84242). Mont Schuyler. 2000 w. Eng News-Rec—Feb 14, 1918. Employment management being introduced in all departments.

Power

Mastering Power Production — III. (84566 A). Walter N. Polakov. 3000 w. Ind Man—March, 1918. Third article of a serial showing the importance of mastery of materials to secure success.

Railroad Bill

The Railroad Bill in the Senate (84450). George P. McLean. 4500 w. Ry Rev—Feb. 23, 1918. Address opposing government possession and control of railways

Women Workers

See same heading under Management.

WELFARE AND SAFETY

Benefit Association

The Employees' Benefit Association—III. (84572 A). W. L. Chandler. 5500 w. Ind Man—March, 1918. Services to be rendered and benefits paid.

Blast Furnaces

Occupational Hazards at Blast-Furnace Plants and Accident Prevention (84372 A). Frederick H. Willcox. Ills. 140 pp. U S Bur Mines—Bul. 140. Based on records of accidents in Penn. in 1915.

Canteens

The Cost of Works' Canteens (84020 A). Ills. & plate. 2500 w. Engng—Jan. 11, 1918. Cost of erection, equipment and maintenance of two English canteens.

Drinking Fountains

Safe and Unsafe Drinking Fountains (84262 A). Ills. 1500 w. Sfty Eng—Jan., 1918. Types of bubblers are critically discussed.

Engine Stops

Engine Stop Systems (84273). Ills. 2000 w. Pwr Pt Eng—Feb. 15, 1918. Safety devices to protect engines for overspeeding.

Factory Restaurant

Factory Employees' Restaurant (84612 A). C. S. Rossy. 500 w. Ind Man—March, 1918. Plan and outline of a "help yourself" restaurant which has proved successful.

Housing

Workpeoples Welfare at a French Explosives Factory (84025 A). Ills. 1000 w. Engr—Jan. 11, 1918. From *Bul. des Usines de Guerre.* Housing accommodation at Sevrati-Livry.

See also same heading under Civil Engineering, *Construction.*

Industrial Health

Illness in Industry—Its Cost and Prevention (84346 D). Thomas Darlington. 15 pp. A I M E, Bul—Feb., 1918. How physiology may be applied to working conditions. Importance of health to industry.

Illness in Industry: Its Cost and Prevention (84556 A). Thomas Darlington. 5500 w. Sfty Eng—Feb., 1918. Calls attention to causes of illness and what may be done to improve conditions.

Industrial Rules

Violation of Industrial Rules (84563 A). Chesla C. Sherlock. 1800 w. Ind Man—March, 1918. Law in regard to compensation for accidents.

Industrial Safety

Five Men in the Shops Behind Every Man in the Trenches (84555 A). David M. Allan. 3000 w. Sfty Eng—Feb., 1918. Calls attention to injuries due to carelessness and how to avoid them.

Mine Accidents

Mine Accidents Classified by Mining Methods for the Lake Superior District, 1915 (84420 N). Albert H. Fay. 1800 w. L S Min Inst, Pro—1917. Accident data classified by causes and mining methods.

Mine Labor and Accidents (84345 D). Herbert M. Wilson. 1000 w. A I M E, Bul—Feb., 1918. Relation of personnel work to accident prevention.

Occupations

Protected Occupations (84469 A). 3500 w. Jr & Cl Trds Rev—Feb. 1, 1918. Main features of a revised schedule which went into effect in England Feb. 1, 1918.

Organization

Fisk Rubber Company's Organization for Safety (84554 A). H. L. Martin. 1700 w. Sfty Eng—Feb., 1918. Details of organization and its work.

Safety Rules

Calumet of Arizona Safety Rules (84364). 3300 w. Min of Sci Pr—Feb. 16, 1918. Practical rules in force.

Safety Work

The Electrical Safety Work of the Bureau of Standards (84557 A). Morton G. Lloyd. 2500 w. Sfty Eng—Feb., 1918. Study of accident statistics and hazards.

Shop Sanitation

Washing Facilities for Industrial Plants (84260 A). A. C. Carruthers. Ills. 1800 w. Sfty Eng—Jan., 1918. The importance of washing facilities, with examples.

Switches

Safety Enclosed Switches (84261 A). Walter Greenwood. 3000 w. Sfty Eng—Jan., 1918. Principles of a safety switch.

Welding

"Safety First" in the Oxy-Acetylene Industry (84259 A). B. Kopferschmith. 2000 w. Sfty Eng—Jan., 1918. Calls attention to unsafe practices in welding.

MISCELLANY

Russia

The Industrial Disintegration of Russia (83989 A). Sterling H. Bunnell. 2500 w. Iron Age—Jan. 31, 1918. Recent observations and opinions.

War Protection

War Protection for Industrial Plants (84562 A). Thomas W. Gregory. 1200 w. Ind Man—March, 1918. Duties of employers in protecting American factories against sabotage and disloyalty.

MECHANICAL ENGINEERING

AERONAUTICS

Aerodynamic Laboratory

The Aerodynamic Laboratory at Leland Stanford Junior University and the Equipment Installed with Special References to Tests on Air Propellers (84448). William F. Durrand Ills. 2500 w. A A Wkly—Feb. 25, 1918. Serial. 1st part.

Aircraft

Commercial Future of Aircraft (84551 B). William B. Stout. Ills. 2500 w. S A E, Jl—Feb., 1918. Fundamentals regarding the work and changes expected.

International Aircraft Standards Adopted by the International Aircraft Standards Board (84449). 4000 w. A A Wkly Feb. 25, 1918. Specifications.

Metals Used in the Construction of Aircraft (84086). Charles Vickers. 2500 w. Fndry—Feb., 1918. Importance of cast iron, semi-steel, aluminum, brass and bronze in the building of airplanes.

Airplanes

The Technical History of the Airplane (84046). F. M. Green. Ills. 4500 w. Auto Ind—Jan. 31, 1918. How the various elements have been developed.

Types of Military Airplanes (84034 B). V. E. Clark. 1800 w. S A E, Jl—Jan., 1918. Types as influenced by the military functions and as influencing the design of the engine.

Women in Airplane Production (84096). J. William Chubb. Ills. 1800 w. Am Mach—Feb. 7, 1918. In Great Britain women are successfully filling positions of skilled mechanics.

Anti Aircraft

Formole Per Le Traiettorie Antiaerce (84575 C + D). G. Manetti. 2200 w. Rivista Marittima—Oct., 1917. Mathematical treatment of trajectory of anti-aircraft projectiles.

Aviation

Trois Ans D'Expériences Sur L'Aéroplane (84593 C + D). M. J. Legrand. Ills. 11000 w Bul Soc D'Encouragement Pour L-Industrie Nationale—Sept.-Oct., 1917. Progress in aeroplane construction during last three years.

Bombing

The Problem of Defeating Germany and How It Can Be Accomplished (84220 A). Norman H. Read. Ills. 4000 w. Flying—Feb., 1918. Urges construction of great fleets of super-bombing machines, able to fly across the Atlantic.

Castor Oil

How Castor Oil Produced in the South May Save the Nation (84153). Howard L. Clark. 1200 w. Mfrs Rec—Feb. 7, 1918. The only oil to meet the requirements of aviation engines. The South to plant 200,000 acres with castor beans.

Engines

The Benz 230-Hp. Aircraft Engine (84293). Ills. 1500 w. Auto Ind—Feb. 14, 1918. Serial, 1st part. Cast-iron cylinder and head castings in one piece and sheet steel jackets.

Flying Models

A Flash Steam Plant for Large Flying Models (84447). A. Koster. Ills. 300 w. A A Wkly—Feb. 18, 1918. Serial, 1st part. Compact and efficient power plant.

Hydrogen Plant

A Suggested Type of Portable Hydrogen Plant (84309). Ills. 1000 w. A A Wkly—Feb. 18, 1918. Detailed description.

Liberty Engine

Reasons Behind the Liberty Aviation Engine (84035 B). Jesse G. Vincent, with discussion. 3000 w. S A E, Jl—Jan., 1918. Brief account of the designing.

Photography

Military Aerial Photography (84219 A). M. Gervais-Courtellemont. Ills. 1000 w. Flying—Feb., 1918. Technical details.

Propellers

La Fabrication Mécanique Des Hélices Aériennes (84608 B). J. Boyer. Ills. 2300 w. La Nature—Jan. 12, 1918. Construction of aeroplane propellers. Methods of increasing production by machines.

AUTOMOBILES

Efficiency

Automotive Industrial Efficiency (84043 B). George C. McMullen. Chart & Ills. 5000 w. S A E, Jl—Jan., 1918. Requirements essential to successful production.

Electric Tractors

Electric Tractors and Trucks (84318). Ills. 6000 w. Ry Rev—Feb. 16, 1918. Types used, their efficiency, etc.

Engine Cooling

Principles of Tractor Engine Cooling (84550 B). Arthur B. Modine. Ills. 2500 w. S A E, Jl—Feb., 1918. Essentials of cooling, giving a formula for radiator sizes and recommendations for water circulation, air velocity, and fan details.

Engines

Changes in Peerless Eight and Reasons Therefor (84294). Ills. 700 w. Auto Ind—Feb. 14, 1918. Important and minor changes made.

Design of Class B Truck Engine (84037 B). A. F. Milbrath. Diagrams. 2500 w. S A E, Jl—Jan., 1918. Requirements and details of design.

Fundamentals of Tractor Engine Design (84197). H. C. Buffington. Ills. 2500 w. Auto Ind—Feb. 7, 1918. Features advocated.

Farm Tractors

Farmers' Service Requirements (84548 B). George Cormack. 4000 w. S A E, Jl—Feb., 1918. Urges the designing and building of the best tractor for the service.

Fuel

Fuel for Automotive Apparatus (84040 B). E. W. Dean. 6000 w. S A E, Jl—Jan., 1918. Deals with liquid fuels for internal combustion engines.

Heat-Flow

Heat-Flow Through Cylinder Walls (84041 B). Louis Illmer. 7000 w. S A E, Jl—Jan., 1918. Research study into speed limitations of internal-combustion engines imposed by excessive heat-flow.

Industrial Trucks

New Type "Hunt" Electric Industrial Truck (84137 A). Ills. 500 w. Elec'n—Jan. 18, 1918. Specification and points of interest.

Lorries

Designing by Committee (84010 A). Ills. 1000 w. Autocar—Jan. 12, 1918. Account of the designing of the U. S. A. war lorry.

Military Transport

Rail and Motor Transport as Applied to Military Operations (84489 B). P. S. Bond. 15 pp. Prof Mem—Jan. Feb., 1918. Effect of transportation on warfare.

Motor Fuel

Motor Spirit and Gas: A Consolidation Order (84011 A). 3500 w. Autocar—Jan. 12, 1918. Text of an English order for restricting use.

Motor Trucks

Akron to Boston (84380 A). Joseph Husson. Ills. 3500 w. Com Vhle—Feb. 15, 1918. Account of 740 miles on regular schedule.

Chassis Design of Class B Motor Trucks (84036 B). Cornelius T. Myers. Ills. 2500 w. S A E, Jl—Jan., 1918. Details.

Transmissions for the Class B Truck (84038 B). A. W. Copland. Ills. 1700 w. S A E, Jl—Jan., 1918. Details of transmission and practice.

Parts List

A Systematic Parts List (84047). R. C. Barron. 2000 w. Auto Ind—Jan. 31, 1918. Nature and need for it in manufacturing.

Passenger Cars

What the Automobile User Is Demanding (84198). J. Edward Schipper. 3500 w. Auto Ind—Feb. 7, 1918. Read before Cleveland Sec., S. A. E. Demands affected by the war.

Road Haulage

Traction on Bad Roads or Land (84284 A). L. A. Legros. Ills. 3000 w. Engng—Jan. 25, 1918. Serial, 1st part. Methods of overcoming difficulties peculiar to such traction.

Starting

Effects of Low Temperatures on Starting (84437). O. W. A. Oetting. Ills. 3000 w. Auto Ind—Feb. 21, 1918. Congealing of oil and decrease in efficiency of starters at low speeds.

Tank Designs

Fuel Tanks and Other Sheet Metal Parts (84292). Ills. 1800 w. Auto Ind—Feb. 14, 1918. Tank designs worked out by Geuder, Paeschke, & Frey.

Tires

Size, Inflation Pressure and Construction of Tires As Affecting Easy Riding (84042 B). W. S. Wolfe, with discussion. Ills. 5000 w. S A E, Jl—Jan., 1918. Considers types, their qualities, etc.

Tractors

Factors Governing Small Tractor Design (84552 B). Alan E. L. Chorlton. Read before Instn. Auto Engrs., London. Ills. 5000 w. S A E, Jl—Feb., 1918. Requirements for an agricultural power unit, principal uses governing design, etc.

Fundamentals of Tractor Design (84290). George T. Strite. 3500 w. Auto Ind—Feb. 14, 1918. Read at Chicago S. A. E. meeting. Deals with size, horsepower, and drawbar pull.

The Twin City "16" Oil Tractor (84291). P. M. Heldt. Ills. 2000 w. Auto Ind—Feb. 14, 1918. Chief characteristics described.

Traction Transmission (84196). E. R. Greer. Ills. 2000 w. Auto Ind—Feb. 7, 1918. Little chance for standardization. Pros and cons of different transmissions.

Truck Axles

Design of Military Truck Axles (84039 B). G. W. Carlson. Ills. 1800 w. S A E, Jl—Jan., 1918. Work of the axle engineers.

Trucking

The Economy of Centralized Trucking (84570 A). J. M. Van Harlingen. Ills. 2500 w. Ind Man—March, 1918. Increased production and reduction in cost by use of electric trucks.

COMBUSTION MOTORS

Ignition

Magneto vs. Battery Ignition (84308). J. B. Williams. Ills. 4500 w. A A Wkly—Feb. 18, 1918. Discusses the two systems.

Troubles and Their Remedies in Gas-Engine Ignition Systems (84368). A. L. Brennan, Jr. 2000 w. Power—Feb. 19, 1918. How to locate and correct various troubles.

Marine Engine

See same heading under Marine and Naval Engineering.

HEATING AND COOLING

Electric Heat

Low-Temperature Industrial Heating (84055). Dwight D. Miller. Ills. 3000 w. Elec Rev, Chi—Feb. 2, 1918. Serial, 1st part. On electric heat for baking, japanning, and similar industrial uses.

Evaporation

Some General Aspects of Evaporation and Drying (84071 A). Hugh K. Moore. 4500 w. Met & Chem Eng—Feb. 1, 1918. Serial, 1st part. General theory and practice.

Fuel Saving

Fuel Saving in Household Heating (84173 A). Robert E. Dillon. Ills. 3000 w. Gen Elec Rev—Feb., 1918. Urges efficient management of domestic heating plants.

Rerigeration

Engineering in the Dairy Industry (83999). Ills. 1500 w. Pwr Pt Eng—Feb. 1, 1918. Refrigerated air employed to cool storage rooms.

Latent Heat of Vaporization of Ammonia (84168). Nathan S. Osborne and Milton S. Van Dusen. 30 pp. U S Bur Stds, No. 315—Dec. 21, 1917. Describes calorimeter designed to determine the latent heat.

Specific Heat of Liquid Ammonia (84166). Nathan S. Osborne and Milton S. Van Dusen. 44 pp. U S Bur Stds, No. 313—Dec. 13, 1917. Data of importance to refrigerating engineers.

The Absorption Refrigerating Machine (84003). W. L. Myer. Ills. 1200 w. Pwr Pt Eng—Feb., 1918. Parts of the system and their functions.

The Latent Heat of Pressure Variation of Liquid Ammonia (84167). 1500 w. U S Bur Stds, No. 314—Nov. 16, 1917. Results of research.

Thawing Plant

Coal Car Thawing Plant Built of Precast Concrete Units (84008). Scott W. Linn. Ills. 1200 w. Eng News-Rec—Jan. 31, 1918. Hot air is blown around trains of cars containing frozen coal housed in unit concrete building.

HYDRAULIC MACHINERY

Turbines

Largest High-Head Francis Turbine (84065). Arnold Pfau. Ills. 2000 w. Power—Feb. 5, 1918. Hydro-electric equipment installed near Sumner, Wash. New 25,000 h. p. unit.

Extreme Schnelläuferturbinen (84581 B). W. Zuppinger. Ills. 1500 w. Schweizerische Bauzeitung—Dec. 1, 1917. Design of high speed vertical water turbines.

MACHINE WORKS & FOUNDRIES

Aluminum

Handling Aluminum in the Foundry (84542). Charles Vickers. Ills. 3500 w. Brs Wld—Feb., 1918. Manipulation of the metal; how to avoid losses.

Brakes

Centrifugal Brakes and Clutches (84251 A). C. C. Richards. Ills. 2000 w. Mech Wld—Jan. 25, 1918. Advantages, and designing.

Brass

Melting Brass in the Induction Furnace (84414 N). G. H. Clamer. Ills. 15 pp. A I Mt, Jl—Dec., 1917. Deals particularly with the Ajax-Wyatt form of induction furnace. Points requiring consideration.

Brass Works

Modern Plant for Manufacturing Brass (84439 A). Ills. 2000 w. Iron Age—Feb. 21, 1918. Straight line routing in Cleveland works.

Casting Prices

Steel Casting Prices Fixed by the Government (84085). 7 pp. Fndry—Feb., 1918. Schedule of agreed quotations on cast parts, including rolls and pinions.

Castings

Casting Pipe Sections by Continuous Pouring (84088). Ills. 2500 w. Fndry—Feb., 1918. Unique pouring and conveying systems.

Cast Iron

Scraping Cast-Iron Surfaces (84250 A). W. H. Rhodes. Ills. 1500 w. Mech Wld—Jan. 25, 1918. Notes on methods used by most of the large machine-tool firms.

Cast Steel

Electric Furnace and Steel Converter Compared (84087). C. R. Messinger. 2000 w. Fndry—Feb., 1918. Results obtained by both mediums for cast steel.

Cores

Brass Foundry Core-Making (84416 N). H. M. Lane. 6 pp. A I Mt, Jl—Dec., 1917. Suggestion for economy.

Crucibles

Notes on the Crucible Situation (84411 N). A. V. Bleininger, with discussion. 18 pp. A I Mt, Jl—Dec., 1917. The manufacture and use.

Files

The Sheffield File-Making Industry (84470 A). 1500 w. Ir & Cl Trds Rev—Feb. 1, 1918. Reviews the present condition and needs of this industry.

Fluxes

Note on the Question of Fluxes (84417 N). E. A. Frohman, with discussion. 1500 w. A I Mt—Dec., 1917. Deals particularly with fluxes for non-ferrous metals.

Flywheels

Flywheel Design for Rolling Mills (83991 A). G. E. Stoltz. 2500 w. Iron Age—Jan. 31, 1918. From paper before Am. Assn. of Iron & Steel Elec. Engrs. Selection and use of load curves.

Moulding Fly-Wheels (84014 A). Joseph Horner. Ills. 1000 w. Mech Wld—Jan. 11, 1918. Serial, 1st part. From *Foundry Trade Journal*. Details of the work.

Forgings

Notes on Crane Forgings (84252 A). Joseph Horner. Ills. 2000 w. Mech Wld—Feb. 1, 1918. Serial, 1st part. Details of methods used in making.

Foundries

Advanced Ideas in Gray-Iron Foundry (84238 A). Charles Lundberg. Ills. 1500 w. Iron Age—Feb. 14, 1918. Methods in a Chicago plant.

Furnaces

High-temperature Resistance Furnaces with Ductile Molybdenum or Tungsten Resistors (84362 D). W. E. Ruder. Ills. 1200 w. A I M E, Bul—Feb., 1918. Describes horizontal and vertical tubular furnaces, and a vacuum tungsten furnace.

Gages

Making Whitworth Thread Gages (83977 A). Walter D. Woodworth and Herman H. Bender. Ills. 11000 w. Machy—Feb., 1918. Reviews practice of a successful manufacturer.

Gasoline Motors

Building Motors with General-Purpose Machines (84241). Ills. 1500 w. Am Mach—Feb. 14, 1918. Serial, 1st part. How these machines are utilized in the manufacture of gasoline engines.

Grinding

The Grinding Wheel in the Foundry (83990 A). W. T. Montague. 4000 w. Iron Age—Jan. 31, 1918. From paper before Am. Found Assn. Factors contributing to their economical use.

Guns

The Erosion of Guns (84351 D). Henry M. Howe. Ills. 55 pp. A I M E, Bul—Feb., 1918. Treats of the hardening of the bore; the cracking of the bore; and possible palliatives of erosion.

Heat Treatment

Possibilities of Double Heat-Treatment of Steel (83987 A). Bradley Stoughton. 1200 w. Machy—Feb., 1918. Abstract of an address before the Steel Treating Research Society of Detroit. The object, and some accomplishments.

Jigs

Jig for Drilling Circular Screwing Dies (84012 A). Ills. 1000 w. Mech Wld—Jan. 11, 1918. Detailed description.

Machine Tools

5-Inch Spindle Duplex Boring, Drilling, and Milling Machine (84285 A). Ills. 900 w. Engng—Jan. 25, 1918. Detailed description.

Malleable Iron

Malleable Cast Iron (84140 A). E. Adamson. From a paper before the Staffordshire Ir. & St. Inst. 2500 w. Colly Gdn—Jan. 18, 1918. Points to consider in the production of malleable iron castings.

Operation Diagrams

Operation Diagrams for the Executive (84564 A). Adalbert R. De Kuzelewski. Ills. 1800 w. Ind Man—March, 1918. How processes of manufacture and machine work may be visualized.

Polishing

The Polishing Room (84544). J. F. Springer. Ills. 2500 w. Brs Wld—Feb., 1918. Pickling; treatment of the iron by the molder, etc.

Punching

Gag Punch for Structural Punch Press (84240). J. V. Hunter. Ills. 2000 w. Am Mach—Feb. 14, 1918. An efficient device for increasing the output of punch presses used on structural steel work.

Repetition Work

The Science of Quick Repetition (84129 N). W. Wilson. Ills. 1200 w. Comwh Engr—Jan., 1918. Serial, 1st part. Experiences in British engineering shops. Speeding up munition making.

Rifle Grenades

Making Malleable Cast Iron Rifle Grenades (84084). Ills. 3000 w. Fndry—Feb., 1918. How a daily average production of 25,000 of these castings was attained.

Screw Threads

Precision Screw Measuring Machine (83978 A). Ills. 1800 w. Machy—Feb., 1918. Apparatus for measuring pitch, pitch diameter, external diameter and angle of screw thread.

Thread-Cutting Attachments (83985 A). Franklin D. Jones. Ills. 7000 w. Machy—Feb., 1918. Standard and special mechanisms and attachments, and their use.

Tempering

Time Effect in Tempering Steel (84350 D). A. E. Bellis. 600 w. A I M E, Bul—Feb., 1918. Its importance when a maximum drawing effect is desired. Tests.

Tools

Combustion Tools and Their Application (83983 A). Ills. 1000 w. Machy—Feb., 1918. Tools for performing a series of operations at one setting.

Treasure Chest

The Old-Time Iron Treasure Chest (83988 A). Alexander E. Outerbridge, Jr. Ills. 2500 w. Iron Age—Jan. 31, 1918. Recent interesting discovery in Philadelphia. Methods of manufacture.

Turning Machine

Large Crank Pin Turning Machine (84146 A). Ills. 1200 w. Engr—Jan. 18, 1918. Details of a machine built in Manchester, England.

Welded Tires

Microscopic Study of Welded Tires (84186 A). S. W. Miller. Ills. 2500 w. Ry Mech Engr—Feb., 1918. Showing dangers of the practice.

Welding

A Counter Attack on German Vandalism (83994 B). Ills. 2500 w. Mar Rev—Feb., 1918. Account of repairs to wrecked German ships.

Oxy-Acetylene and Electric Welding (84079 A). 1500 w. Ry & Loc Eng—Feb., 1918. Abstract of paper by A. F. Dyer, before Can. Ry. Club. Some of the work described.

Some Structures in Steel Fusion Welds (84352 D). S. W. Miller. Ills. 18 pp. A I M E, Bul—Feb., 1918. Unusual structures encountered in the examination of welds.

MATERIALS OF CONSTRUCTION

Alloys

Eutectic Alloys (84531 N). Clifford W. Nash. Ills. 3000 w. Chem Eng & Min Rev—Jan., 1918. Serial, 1st part. A study of the structure of metals.

Occluded Gases in Ferrous Alloys (84374 B). Gellert Alleman and Charles J. Darlington. 37 pp. Fkn Inst, Jl—Feb., 1918. Serial, 1st part. Reviews work of investigators.

Aluminum

Metallography of Aluminium (84275 A). Robert J. Anderson. Ills. 3000 w. Met & Chem Eng—Feb. 15, 1918. Methods for satisfactory preparation and etching of aluminium microsections and discussion of microstructure.

See same heading under *Machine Works and Foundries*.

Analyses

The Analyses of Brass or Bronze and Babbitt (84413 N). E. W. Haymaier. 10 pp. A I Mt, Jl—Dec., 1917. Methods found satisfactory for commercial analyses.

Bronzes

The Use of Bronzes in Railroad Turntables and Movable Bridges (84412 N). O. E. Selby. 10 pp. A I Mt, Jl—Dec., 1917. Conditions and requirements, discussing specifications.

Castings

Copper Castings for Electrical Purposes (84495 N). G. F. Comstock. Ills. 2000 w. Am El-Chem Soc. Trans—Oct., 1918. Reviews history of attempts and difficulties and gives results of using silicon as a dioxidizer.

Fuel

Assisting Fuel Administration (84221 A). M. J. O'Connell. 2000 w. Ice & Refrig—Feb., 1918. Read before the Va. Ice Mfrs. Assn., at Richmond. Suggestions.

Fuel Oil

Storage and Handling of Fuel Oil (83,997). Charles L. Hubbard. Ills. 5000 w. Natl Engr—Feb., 1918. Approved method.

Lubricating Oils

Standardized Specifications for Lubricating Oils (84540 B). C. W. Stratford. Ills. 4500 w. S A E, Jl—Feb., 1918. Recommended specifications based on extensive tests.

Magnesia

The Refractory Properties of Magnesia (84017 A). H. Le Chatelier and B. Bogitch. 600 w. Colly Gdn—Jan. 11, 1918. From *Acad. des Sci.* Resistance of magnesia bricks. Results of tests.

Metal Structure

The Amorphous Metal Hypothesis and Equi-cohesive Temperatures (84409 N). Zay Jeffries, with discussion. Ills. 25 pp. A I Mt, Jl—Dec., 1917. Discussion of the crystalline structure of metals and the amorphous metal hypothesis.

Natural Resources

See same heading under Civil Engineering, *Materials of Construction.*

Ordnance Inspection

Building Up the Ordnance Inspection Department (84098). Glenn B. Harris. 1200 w. Am Mach—Feb. 7, 1918. Information in regard to the work involved.

Sands

The Occurrence and Testing of Foundry Moulding Sands (84515 N). L. Heber Cole. Ills. 27 pp. Can Min Inst, Trans—1917. Field work and conclusions from tests.

Schoop Process

Vom Schoop'schen Metallspritzverfahren (84583 B). Ills. 1700 w. Schweizerische Bauzeitung—Dec. 29, 1917. Methods and apparatus for use with the Schoop metal spraying process for protecting surfaces.

Steel

Les Points Critiques De Refroidissement Des Aciers Auto-Trempants (84,591 C+D). M. P. Dejean. Ills. 7500 w. Revue De Métallurgie—Sep.–Oct., 1917. Critical cooling points of self-tempering steels, and the formation of Troostite and Martensite.

Tool Steel

Détermination Du Meilleur Mode D'-Emploi Des Aciers À Outils (84605 B). P. Denis. Ills. 4800 w. Le Génie Civil—Jan. 5, 1918. Tests on tool steels.

MEASUREMENT

Balancing

Recent Developments in Balancing Apparatus (83979 A). Ills. 2000 w. Machy—Feb., 1918. New form of dynamic balancing machine.

Brass

Thermal Expansion of Alpha and of Beta Brass Between 0–600° C., in Relation to the Mechanical Properties of Heterogeneous Brasses of the Muntz Metal Type (84415 N). P. D. Merica and L. W. Schad. Ills. 12 pp. A. I. Mt—Dec., 1917. Investigation and results.

Charts

Simple, Rapid Calculating Chart (84,274). Ralph E. Turner. 2000 w. Pwr Pt Eng—Feb. 15, 1918. Combination of logarithmic charts serves purpose of slide rule with equal accuracy and rapidity.

High Pressures

Measuring High Pressures with Dead Weight (84539). Sanford A. Moss. Ills. 2200 w. Power—Feb. 26, 1918. Details for using the equivalent of the dead-weight pressure-gage tested for measuring pressures during tests.

High Temperatures

Automatic Control and Measurement of High Temperatures (83981 A). Abstract of paper by Richard P. Brown, read before the Faraday Society. Ills. 2200 w. Machy—Feb., 1918. Improvements in measuring instruments and control devices.

Pitot Tube

Measurement of Air and Gases by the Pitot Tube (84002). A H. Anderson. Ills 1200 w. Pwr Pt Eng—Feb. 1, 1918. Tables. Explanation of use

Screw-Gauges

The Inspection of Screw Gauges for Munitions of War ([illegible] A). H. J. Bingham Powell. [illegible] w. Mech Wld—Jan. 18, 1918. Serial, 1st part. Present article deals with the measurement of the pitch.

Turbines

Stresses in Turbine Wheels (83982 A). William Knight. Tables. 1200 w. Machy—Feb., 1918. Methods and values for determining stresses.

Wire Gages

Wire Gages (84373). 5 pp. U S Bur Stds, No. 67—Jan. 17, 1918. Combined table of sizes in the principal wire gages.

POWER AND TRANSMISSION

Ash Handling

Buying an Ash-Handling System (84,068). Herbert E. Birch. 2200 w. Power—Feb. 5, 1918. How to purchase a system to remove ashes from boiler ash-pits.

Bucket-Elevators

Some Practical Hints in Bucket-elevator Operation (84344 D). A. M. Nicholas. 500 w. A I M E, Bul—Feb., 1918.

Cheap Power

The Potentialities of a National Power Scheme (84254 A). Ernest P. Hollis. 5000 w. Ir & Cl Trds Rev—Jan. 25, 1918. Read before Assn. of Min. Elec Engrs. The possibility of a supply of cheap power is considered.

Compressed Air

Compressed Air and Some of Its Applications (84170 A). Joseph B. Mossman. 14 pp. Utah Soc Engrs, Jl—Dec., 1917.

Great Britain

Water Power in Great Britain (with Special Reference to Scotland): Its Amount and Economic Value (84279 A). Alexander Newlands, with discussion. Map. 19 pp. Roy Soc Arts, Jl—Jan. 25, 1918.

Lubrication

Lubrication of Mine Machinery (84521 N). James A. Boyd. 2500 w. Can Min Inst, Trans—1917. Different phases of the subject.

Power Plants

Important Discussion on Varied Power Plant Subjects (84107 A). 16 pp. A S M E, Jl—Feb., 1918. Papers on small turbines, waste of coal, bagasse as fuel, cooling of water, and the steam motor.

Turbines

The Fifty-Thousand Kilovolt-Ampere Connors Creek Turbines (84367). C. F. Hirshfeld. 1500 w. Power—Feb. 19, 1918. Largest single-cylinder turbine.

STEAM ENGINEERING

Boiler Economy

Soot and Scale (84222 A). A. A. Hutchinson. 1800 w. Ice & Refrig—Feb., 1918. Boiler efficiency; loss of heat due to scale, etc.

Condensers

A Fifty-Thousand Sq. Ft. Condenser (84538). Ills. 1500 w. Power—Feb 26., 1918. Condenser located at the bottom of a pit 74 ft. deep.

Modern Condenser Practice (84336 B). D. D. Pendleton, with discussion. Ills. 57 pp. Engrs Soc W Penn, Pro—Nov., 1917. Choice of condenser, types, auxiliaries, etc.

Electric Energy

The Production of Electricity by Steam Power (84498 N). Alex Dow. 18 pp. Am El-Chem Soc, Trans—Oct., 1918. The present status of the production of electric power from steam.

Feed-Water

Reducing Costs of Fuel and Boiler Maintenance (84297). S. B. Applebaum. Ills. 3000 w. Elec Wld—Feb. 16, 1918. How costs can be reduced by softening boiler feed-water.

Testing the Boiler Feed Water (83998). W. A. Taller. 2500 w. Natl Engr—Feb., 1918. Methods for detecting oil, degree of hardness, acidity, or alkalinity, sulphate of lime, etc.

Fuels

A New Method of Burning Powdered Coal (84547 A). Ills. 2000 w. Iron Age—Feb. 28, 1918. A small diameter low-pressure air transport system without return mains.

Turbines

Some Safety Devices for Steam Turbines (84147 A). Ills. and Plate. 3500 w. Engr—Jan. 18, 1918. Devices of the Oerlikon Co. of Switzerland. Their construction and working.

The Historical Development of the Steam Turbine (84264 A). Francis Hodgkinson. 3500 w. A E R A—Jan., 1918. Built as far back as 1833.

TRANSPORTING AND CONVEYING

Handling Materials

Handling Bulk Material by Man and Machine Power—A Comparison (84567 A). George Frederick Zimmer. Ills. 2500 w. Ind Man—March, 1918. Based on British practice. Comparative costs.

MISCELLANY

Discussions

Discussions of Papers on Varied Subjects (84108 A). 8 pp. A S M E, Jl—Feb., 1918. Heat transfer, surface resistance, air purification, balancing, etc.

Further Discussions of Varied Papers (84109 A). 2500 w. A S M E, Jl—Feb., 1918. Papers by F. W. Dean, L. C. Loewenstein, H. L. Gantt, C. J. Ramsburg, and C. H. Bedell.

Filter-Press

The Filter-Press (84074 A). D. R. Sperry. Ills. 2500 w. Met & Chem Eng—Feb. 1, 1918. Construction and functions.

ELECTRICAL ENGINEERING

COMMUNICATION

Loading Coils

Loading Coils versus Repeaters (84224 A). W. N. Furthmann. Ills. 2500 w. Tel Engr—Feb., 1918. Serial, 1st part. Properly designed and correctly installed loading coils adequate for long distance.

Military Communication

Telegraphs and Telephones in the First Year of War (84298). John V. L. Hogan. 1500 w. Elec Wld—Feb. 16, 1918. Organized for war service.

Radiotelegraphy

Comparative Experiments on the Audion (84281 A). G. Vallouri. Diagrams. 1000 w. Elec'n—Feb. 1, 1918. Experiments made with five samples to determine their relative behavior as amplifier, generator, and detector in radiotelegraphy.

Telephone Practice

Semi-Automatic Telephone System at Amsterdam (84225 A). From *Am. des Telegrapes et Telephones.* 3300 w. Tel Engr—Feb., 1918. Reasons for adopting this system; method of service, etc.

Telephone Work

Trucks, Trailers and Special Bodies (84223 A). Ills. 4500 w. Tel Engr—Feb., 1918. Miscellaneous motor cars and attachments found useful to telephone men.

Telephony

Telephone Exchange Transfers and Their Organization (84280 A). F. G. G. Baldwin. 3500 w. Elec'n—Feb., 1918. Abstract of paper before the I. E. E. Ways and methods of effecting transfers.

Train Telephones

Telephoning to a Moving Train (84077 A). Ills. 800 w. Ry & Loc Eng—Feb., 1918. Appliances and system in use on Canadian Government railways.

ELECTRO-CHEMISTRY

Canada

Notes on Electro-Chemical and Metallurgical Possibilities in Canada (84525 N). H. E. Howe, with discussion. 3500 w. Can Min Inst, Trans—1917. Utility of hydro-electric power, and the future of industries named.

"Density Cell"

A "Density Cell" with Slight Local Action (84138 A). Ch. Fery. Abstract of paper read before the Soc. Int. des Elec'ns. Ills. 2500 w. Elect'n—Jan. 18, 1918. Experiments designed to provide a remedy for the irregular local action of the negative electrode.

Depolarizing

Pile A Dépolarisation Par L'Air (84,592 C + D). M. Féry. Ills. 1200 w. Bul-Soc D'Encouragement Pour L'Industrie Nationale—Sept.-Oct., 1917. Voltaic cell with manganese dioxide electrolyte arranged to depolarize the negative plate by allowing access of air.

Electric Furnace

The Greaves-Etchells Electric Furnace (84148 A). Ills. 1500 w. Engr—Jan. 18, 1918. Detailed description and advantages claimed.

Electrometallurgy

Electro-Deposition of Zinc from Aqueous Solutions (84506 N). E. P. Mathewson, with discussion. 26 pp. Can Min Inst, Trans—1917. Bibliography and the process finally adopted.

Electrolytic Zinc Extraction at Trail, B. C. (84497 N). E. H. Hamilton. 500 w. Am El—Chem Soc, Trans—Oct., 1917. Composition of the ore and details of the work.

Electrolytic Zinc in Eastern Canada (84507 N). E. E. Watts. 2500 w. Can Min Inst, Trans—1917. Experimental work and conclusions.

The Future of Electrolytic Zinc (84,496 N). Thomas French. 2200 w. Am El-Chem Soc, Trans—Oct., 1917. Comparative merits of the retort process and the electrolytic process of extracting zinc from its ores.

Plating

Plating of Die Castings (84543). Joseph Haas, Jr. 2200 w. Brs Wld—Feb., 1918. Solutions tried out and results given.

Rossi, A. J.

Presentation of Perkin Medal to Auguste J. Rossi (84069 A). Ills. 7000 w. Met & Chem Eng—Feb. 1, 1918. Account of meeting at Chemists' Club, N. Y., with full text of addresses.

Thermoelectric Cell

A Thermoelectric Standard Cell (84,379 D). C. A. Moxie. Ills. 8 pp. A I E E, Pro—Feb., 1918. Considers a means of obtaining a secondary standard of e. m. f. by utilizing the e. m. f. of a thermocouple.

Water Power

Water Power—Our Electrochemical Salvation (84172 A). C. A. Winder. Ills. 2500 w. Gen Elec Rev—Feb., 1918. Claims that water of Niagara Falls could be largely diverted for power purposes without detracting from the beauty of this cataract.

Water Power Legislation (84494 N). Map. 4500 w. Am El-Chem Soc, Trans—May, 1917. Presents needs of electrochemical industries.

ELECTRO-PHYSICS

Hysteresis

The Suppression of Hysteresis in Iron-carbon Alloys by a Longitudinal Alternating Magnetic Field (84177 A). C. W. Waggoner and H. M. Freeman. 2000 w. Gen Elec Rev—Feb., 1918. Remarkable experiments on the disappearance of hysteresis.

Inductance

Self-Inductance of Long Reactance Coils (84213). H. B. Dwight. 1200 w. Elec Wld—Feb. 9, 1918. Develops formula for computing value, with two examples to illustrate application.

Induktion und Kapazität von Leitungen (84587 B). J. Fischer-Hinnen. Ills. 10,000 w. Bul-Schweiz. Elektrotechnischer Verein—Dec., 1917. Induction and capacity of conductors. Mathematical.

The Inductance of Tubular Conductors (84205). H. B. Dwight. Ills. 500 w. Elec Rev, Chi—Feb. 9, 1918. Derives a fairly simple formula for inductance of circuits using tubular conductors.

Wave Motion

Electric Waves (84472 B). W. S. Franklin and Barry McNutt. Ills. 34 pp. West Soc Engrs, Jl—Nov., 1917. Discussion of the simplest aspects of the dynamics of wave motion

GENERATING STATIONS

Calgary

The Central Station at Calgary (84204). James F. McCall. Ills. 2000 w. Elec Rev, Chi—Feb. 9, 1918. Details of a municipal electric plant in Alberta, Can.

Coal Saving

Bonus Plan Reduces Coal Consumption at Manila (84313). B. H. Blaisdell. 4000 w. Elec Ry Jl—Feb. 16, 1918. Dividing saving effected with power plant employees gives men increase in wages of about $700 per month.

Columbus

Walnut Station of Columbus Railway, Power & Light Company (84459). Ills. 4500 w. Elec Rev, Chi—Feb. 23, 1918. New steam-electric generating station.

Great Britain

Proposed Interconnection of Electric Power Supply in Great Britain (84206). 4500 w. Elec Rev, Chi—Feb. 9, 1918. Interim report of Coal Conservation Sub-Committee dealing with power generation and transmission.

Hydro-Electric

Hydro-Electric Development (84193). Calvert Townley. 3500 w. Can Engr—Feb. 7, 1918. Presented to the Water Power Committee of the U. S. Chamber of Commerce. On estimated undeveloped water power and its industrial value.

Impianto Idroelettrico Del Corfino (84,603 B). A. Omodeo. Ills. 3600 w. Industria—Jan. 15, 1918. Hydro-electric development on Corfino River in Italy. Interesting features.

Ireland

Electricity Supply in Dublin and the Surrounding Districts (84139 N). W. Tatlow, with discussion. 6500 w. Instn Elec Engrs, Jl—Jan., 1918. Urges the concentration of generating plant, and considers improvements and legislation needed.

Isolated Plant

Isolated Plant for Foundry and Machine Shop (84272). Ills. 1000 w. Pwr Pt Eng—Feb. 15, 1918. New Chicago factory having a small but modern power plant with standard equipment.

Mine-Mouth Power

Bulk-Supply Generating Station at Mouth of Mine (84211). Ills. 2500 w. Elec Wld—Feb. 9, 1918. Serial, 1st part. Features of the Windsor (W. Va.) power plant operated jointly by two companies.

The Windsor Power Station (84217). Ills. 3500 w. Power—Feb. 12, 1918. Features of plant at coal mine in W. Va. to produce bulk energy for joint mine owners.

New Bedford

New 52,000 kw. Station of New Bedford Company (84461). Ills. 1500 w. Elec Wld—Feb. 23, 1918. Serial, 1st part. Engineering features of the largest steam-turbine plant in South Massachusetts.

Power Generation

Combining Loads to Gain Economies of Large Units and High Diversity Factor (84201). 2200 w. Elec Ry Jl—Feb. 9, 1918. Serial, 1st part. Huge jointly owned steam generating plant at Windsor, W. Va.

See also Turbines, under MECHANICAL ENGINEERING, *Hydraulic Machinery.*

GENERATORS AND MOTORS

Cap-Rings

Turbo-Rotor Cap-Rings (84136 A). R. Roberts. Ills. 1600 w. Elec'n—Jan. 18, 1918. Serial, 1st part. Calculations of stress, and points in design.

Clutch

Differential Electro-Magnetic Clutch (84289 A). Ills. 2500 w. Engr—Jan. 25, 1918. Details of clutch, devised by Walter L. Davies and Alfred Soames, for controlling the electrical output of a dynamo and the mechanical output of a motor.

Magnetic Clutch (84287 A). Ills. 1500 w. Engng—Jan. 25, 1918. Describes an automatic magnetic clutch.

Commutation

Commutation in Alternating-Current Machinery (84385 D). Marius C. A. Latour. Ills. 25 pp. A I E E, Pro—Feb., 1918. Theoretical considerations of commutation in polyphase and single-phase machinery.

Commutators

The Care of Commutators of Direct-Current Machinery (84015 A). L. Fokes. 3000 w. Colly Gdn—Jan. 11, 1918. Proper attention to repairs and to points that will avoid their necessity.

Dynamo Design

Output Coefficients for D. C. Motors of Small Size (84296). E. W. Kellogg. 800 w. Elec Wld—Feb. 16, 1918. Convenient method of arriving at trial values of armature diameter and length before designing the winding.

Motor Operation

Applications of Flywheels in Motor Operation (84462). C. E. Clewell. Ills. 2000 w. Elec Wld—Feb. 23, 1918. Theoretical and practical considerations of the effect which they exert.

Motors

The Polyphase Shunt Motor (84382 D). W. C. Korthals Altes. Ills. 32 pp. A I E E, Pro—Feb., 1918. Types that seem most important are discussed, particularly the induction motor with commutator on the primary side.

Protection

The Protection of Alternating Current Generators (84324 N). J Harcourt Williams. Ills. 1000 w. Beama Jl—Jan., 1918. Describes protective devices and their advantages.

Secomor

The Secomor. A Kinematic Device which Imitates the Performance of a Series-wound Polyphase Commutator Motor (84380 D). V. Karapetoff. Ills. 18 pp. A I E E, Pro—Feb., 1918. Describes the device and its purposes.

Starters

Alternating-Current Automatic Starters for Squirrel-Cage Induction Motors (84,067). W. H. Patterson. Ills. 1500 w. Power—Feb. 5, 1918. Operation explained. Applications and limitations.

ILLUMINATION

Color

A Color Symposium (84396 C). Articles by C. E. Ferree and G. Rand, Beatrice Irwin, M. Luckiesh, Irwin G. Priest, H. C. Richards, Leonard Thompson Troland, and discussions. 82 pp. Ill Eng Soc, Trans—Feb. 11, 1918.

Lighting Economics

Economics in the Operation of Large Lighting Installations (84397 C). Clarence L. Law and James E. Buckley, with discussion. 18 pp. Ill Eng Soc, Trans—Feb. 11, 1918. Executive details and routines necessary.

Underground Lighting

The Design of Low Voltage Underground Lighting Systems (84370 A). L. Fokes. 3000 w. Colly Gdn—Jan. 25, 1918. Present tendency in colliery lighting. Factors which have increased the possibilities of low voltage.

Visible Radiation

The Visibility of Radiation (84398 C). Prentice Reeves, with short discussion. 8 pp. Ill Eng Soc, Trans—Feb. 11, 1918. Comparison of various data obtained in laboratory tests.

MEASUREMENT

Currents

A New Standard of Current and Potential (84381 D). Chester T. Allcutt. Ills. 7 pp. A I E E, Pro—Feb., 1918. A new standard proposed as a substitute for the standard cell in certain classes of d. c. measurements.

Demand Meters

Classification of Demand Meters with Reference to Central-Station Rates (84,460). Chester I. Hall. 1500 w. Elec Rev, Chi—Feb. 23, 1918. Résumé of demand meter development.

The Character of the Thermal Storage Demand Meter (84384 D). P. M. Lincoln. Ills. 22 pp. A I E E, Pro—Feb., 1918. Discusses the character of the quantity measured by this device.

Meter

The Selection of an Electricity Meter (84369 A). 2000 w. Elec Rev—Jan. 25, 1918. Considers quality, cost, and commercial service.

Power Factor Meters

D. C. Calibration of Power Factor Meters (84063). Thomas W. Varley. 800 w. Elec Wld—Feb. 2, 1918. Resistance ratio method.

Power Losses

Measurement of Power Loss in Dielectrics of Three-Conductor High-Tension Cables (84383 D). F. M. Farmer. Ills. 20 pp. A I E E, Pro—Feb., 1918. Method used at the Electrical Testing Laboratories, the difficulties and methods of overcoming them.

Rating

Factors That Determine Maximum Rating of a Direct-Current Machine for a Given Speed (84127 A). F. T Hague. Ills. 4500 w. Elec Jl—Feb., 1918. Analysis of the factors which limit capacity of any machine

POWER APPLICATIONS

Agriculture

Electroculture (84590 B). Ills. 2700 w. L'Industrie Electrique—Dec. 25, 1917. Apparatus for high tension discharge for stimulating plant growth.

Argentina

Argentina as a Field for Electrical Enterprise (84323 N). 4500 w. Beama Jl—Jan., 1918. Progress during the last half century; hints on publicity and merchandizing methods.

Electric Range

A Study of Electric Range Efficiency (84300). R. G. Kloeffler. Ills. 1800 w. Elec Wld—Feb. 16, 1918. Serial, 1st part. Test results on both open and inclosed heating units.

Excavator

Electric Control of a Dragline Excavator (84302). L. W. Nickel. Ills. 1500 w. Cl Age—Feb. 16, 1918. Advantages over steam shovel.

Farm Work

Electricity Speeding Up Farm Work in Idaho (84320). C. O. Crane. Ills. 1800 w. Elec Rev, Chi—Feb. 16, 1918. Advantages of power and light.

Electric Ploughing (84248 A). A. Delamorre. Abstract from *Rev. Gen. de l'Elec.* Ills. 2000 w. Elec'n—Jan. 25, 1918. Serial, 1st part. Amount of power necessary; various systems and methods.

Some Experiments in the Use of Electric Power for Field Work on the Farm (84175 A). J. H. Davidson and F. E. Boyd. Ills. 2200 w. Gen Elec Rev—Feb., 1918. Possibilities of using power from existing transmission lines.

Fertilizer Plants

The Fertilizer Industry and Its Power Requirements (84171 A). J. E. Mellett. Ills. 14 pp. Gen Elec Rev—Feb., 1918. Application of electric drive to this industry, and the average power requirements.

Logging

Electricity in Logging and Saw Mills (84178 A). E. H. Horstkotte. Ills. 11 pp. Gen Elec Rev—Feb., 1918. Power equipment of a large mill in the West.

Steel Mills

Application of Motors to Steel-Mill Operations (84064). C. E. Clewell. Ills. 1800 w. Elec Wld—Feb. 2, 1918. Important operations to which motors have been applied. Types adapted.

Textile Mills

Application of Motors to the Textile Industry (84299). C. E. Clewell. Ills. 1500 w. Elec Wld—Feb. 16, 1918. Factors affecting selection of motors and control apparatus.

Winches

Electric Cargo Winches (84176 A). E. F. Whitney. Ills. 8 pp. Gen Elec Rev—Feb., 1918. Equipment for applying electric drive.

Winding Engines

Electric Winding Engines (84468 A). John F. Perry. Ills. 6500 w. Ir & Cl Trds Rev—Feb. 1, 1918. A comparison of various systems and some aspects of the problem in the event of centralization.

TRANSFORMERS

High-Voltage

High-Voltage Transformers at Alfkarleby (84023 A). Ills. 1200 w. Engng—Jan. 11, 1918. Voltage of 77,000 for hydro-electric power station in Sweden.

Protection

Some Phases of Protecting Distributing Transformers (84057). S. F. Erickson. Ills. 4500 w. Elec Rev, Chi—Feb. 2, 1918. Factors involved in conserving transformer life and capacity.

Voltage

Characteristics of Current Transformers on Open Circuit (84128 A). W. R. Woodward. 1800 w. Elec Jl—Feb., 1918. Explains operation and the dangers.

TRANSMISSION AND DISTRIBUTION

Cables

Cable Fault Localization in Practice (84134 A). D. M. W. Hutchison. Ills. 1400 w. Elec Rev—Jan. 18, 1918. Results of experience. Loop test with a special bridge, and a fall potential test.

Circuit Breakers

Rating and Selection of Oil Circuit Breakers (84378 D). E. M. Hewlett, J. M. Mahoney, and G. A. Burnham. Ills. 16 pp. A I E E, Pro—Feb., 1918. Discusses the interpretations of the A I E E Standardization Rules, and factors involved in selection.

Insulators

Electrical Porcelain (84125 A). G. I. Gilchrest and T. A. Klinefelter. Ills. 3500 w. Elec Jl—Feb., 1918. How a satisfactory product has been developed.

Iron Wire

Ueber die Verwendbarkeit eiserner Fahrleitungen fur Wechselstrombahnen (84584 B). W. Kummer. 2800 w. Schweizerische Bauzeitung—Dec. 22, 1917. The use of iron wire overhead conductors for alternating current railways.

Line Calculations

Simplifying Transmission Line Calculations (84062). T. A. Wilkinson. 2500 w. Elec Wld—Feb. 2, 1918. Method involving new equations and chart based on rigorous formula.

Oil Switches

Die Untersuchungen an Oelschaltern (84585 B). B. Bauer. Ills. 12,000 w. Bulletin Schweizerischer Elektrotechnischer Verein—Oct., 1917. Report of committee on high tension apparatus. Thermodynamics of oil switches.

Pole Lines

The Forces Which Act Upon a Transmission Line (84457). Charles R. Harte. Ills. 3000 w. Elec Ry Jl—Feb. 23, 1918. Means of calculating the factor of safety.

The Mechanics of the Pole Lines (84295). Ward H. Snook. Ills. 2000 w. Telephony—Feb. 16, 1918. Serial, 1st part. Determination of forces acting on pole lines by use of graphics.

Portable Switchboards

Transportable Isolier-Schutzwände fur Hochspannungs-Schaltanlagen (84586 B). E. Sieber. Ills. 1000 w. Bul-Schweiz. Elektrotechnischer Verein—Nov., 1917. Portable switchboards and compartments for high tension apparatus.

Rectifiers

Factors Affecting Vapor-Rectifier Performance (84463). William Tschudy. Wave forms. 1000 w. Elec Wld—Feb. 23, 1918. Bulb losses greatly dependent on wave form, frequency and anode current.

River Crossing

An Interesting Transmission Line River Crossing (84056). Ills. 1500 w. Elec Rev, Chi—Feb. 2, 1918. Features of project of the Toledo Railway & Light Co. Long span over Maumee River.

Synchronizing

Synchronizing Stations to Reduce Interruptions (84214). Ills. 1200 w. Elec Wld—Feb. 9, 1918. Flexibility of operation increased by installing two synchronizing stations.

CIVIL ENGINEERING

BRIDGES

Bascule

Illinois Central Bascule Bridge is Hand Operated (84243). Ills. 1000 w. Eng News-Rec—Feb. 14, 1918. Bridge near Allen, Miss., has plate-girder span fitted with counterweighted lifting truss.

Concrete

Concrete-Arch Railway Bridge Costs Less Than Steel (84387). Ills. 2500 w. Eng News-Rec—Feb. 21, 1918. Double-track concrete structure replaces iron.

Manayunk, Pa.

New Pennsylvania Railroad Bridge at Manayunk, Pa. (84200). Albert M. Wolf. Ills. 1800 w. Ry Rev—Feb. 9, 1918. Design and methods of construction.

Moving

Shifting a 4000-Ton Bridge on Freight Car Trucks (84269). Ills. 2000 w. Ry Age—Feb. 15, 1918. Three spans of St. Joseph & Grand Island structure over the Missouri River moved 136 ft.

Ohio River

The Sciotoville Bridge (84282 A). Frank W. Skinner. Ills. and Plate. 3500 w. Engng—Jan. 25, 1918. Serial, 1st part. Details of bridge across the Ohio River at a height of 110 ft. above low water.

Quebec

Expansion Joints and Traction Trusses, Quebec Bridge (84191). Archibald John Meyers. Ills. 4500 w. Can Engrs—Feb. 7, 1918. Sliding rail expansion joints allow motion of 17½ inches between suspended span and each cantilever arm.

CONSTRUCTION

Administrative Offices

Three Wooden Buildings to Hold 10,000 Government Employees (84389). Ills. 1200 w. Eng News-Rec—Feb. 21, 1918. Offices under construction in Washington, D. C.

Building Details

One-Hundred-Foot Concrete Arch Carries Theater Balcony (84112). Clarence W. Driver. Ills. 1000 w. Eng News-Rec—Feb. 7, 1918. Details of work in Edison building in Los Angeles.

Buildings

Report of Committee VI—On Buildings (84479 N). 28 pp. A R E A, Bul—Dec., 1917.

Concrete

Economy in the Design of Concrete Buildings (84376 B). Clayton W. Mayers. Ills. 26 pp. Bos Soc C E, Jl—Feb., 1918. Effects of design on cost; comparative estimates, etc.

Concrete Houses

Precast and Field Cast Concrete Houses (84058). J. B. Warriner. Ills. 1000 w. Cl Age—Feb. 2, 1918. Construction of dwellings built of a combination of precast and field cast concrete.

Concrete Plant

Concrete Plant on Boston Dry Dock Almost Automatic (84005). Edmund M. Blake. Ills. 2500 w. Eng News-Rec—Jan. 31, 1918. Electrically operated, belt-fed concrete plant of 100 yd. an hour capacity.

Dams

See Water Supply.

Factories

Standardization in Factory Buildings (84438). Ills. 1500 w. Auto Ind—Feb. 21, 1918. Standardized plans, with a structural steel work fabricated in advance.

Flat Slab

Some Notes on Flat Slab Design: Thickness of Slab, Column Heads and Bending in Columns (84545). Albert M. Wolf. Ills. 3500 w. Eng & Con—Feb. 27, 1918. Considers points of importance to designers.

Foundations

Een an Ander Omtrent den Druk van het Grondwater onder Bouwwerken (84,-595 B). R. Soman. 6500 w. De Ingenieur—Dec. 29, 1917. Methods of resisting pressure of ground water in deep foundation work.

Framing

Composite Steel and Concrete and Steel Framing Construction (84133 N). 1500 w. Comwh Engr—Jan., 1918. New regulations for Sydney, Australia.

Girders

Circular-Arc Bow-Girder (84142 A). William Knight. Diagrams. 1500 w. Engng—Jan. 18, 1918. Formulæ, published by A. H. Gibson and E. G. Ritchie of interest to the designer.

Granary

A Modern Granary (84135 A). G. E. Baxter. Details from a paper read before the Instn. of Engrs. & Shipbldrs. in Scotland. Ills. 1800 w. Elec'n—Jan. 18, 1918. Serial, 1st part. Equipment of Meadowside granary, which has a capacity of 31,000 tons of wheat.

Housing

Community Courts for Factory Workers (84328 A). Charles Alma Byers. Ills. 1600 w. Arch Rec—Feb., 1918. Shows this idea as developed in California.

Regular Towns Must Be Built to Adequately House Industrial Armies (84436). Samuel G. Willmer. Ills. 3000 w. Mfrs Rec—Feb. 21, 1918. Outline of what is planned and what is being done.

Some Aspects of Industrial Housing (84082 B). Charles C. May. Ills. 4000 w. Arch For—Jan., 1918. Serial, 1st part. Introductory and examples of industrial town planning from the work of John Nolen.

The Need for Industrial Housing (84,-083 B). 2500 w. Arch For—Jan., 1918. The great problem now before the U. S. Government.

Military Engineering

Deep Gallery Shelters (84486 B). A lecture by P. S. Bond and R. D. Leisk. Ills. 10 pp. Prof-Mem—Jan.-Feb., 1918. Field works in the present war and their construction.

Use of Corrugated Iron for Construction of Shelters (84487 B). Henry Swift. Ills. 10 pp. Prof-Mem—Jan.-Feb., 1918. Uses for which it is adapted.

Mining Operations, Especially for Infantry (84400 B). W. R. Livermore. Ills. 17 pp. Prof-Mem—Jan.-Feb., 1918. History of mine warfare is reviewed.

Mont d'Or Tunnel

Geologische und Hydrologische Beobachtungen über den Mout d'Or Tunnel und dessen Anschliessende Gebiete (84,-582 B). H. Schardt. Ills. 2400 w. Schweizerische Bauzeitung—Dec. 8, 1917. Serial, 1st part. Geology and hydrology of the mountain region of the Mont d'Or tunnel near Vallorbe, Switzerland.

Rapid Building

Concrete Army Warehouses Built in Record Time (84245). Edgar H. Mosher. Ills. 1500 w. Eng News-Rec—Feb. 14, 1918. Low structures of large area expedited by careful arrangement of building processes.

Repairing

Methods of Maintaining and Repairing Old Highway Bridges (84546). G. F. Burch. Ills. 2000 w. Eng & Con—Feb. 27, 1918. Details of methods employed in Illinois.

Wharves

See same heading under *Waterways and Harbors.*

Workmen's City

Building a Town to House Three Thousand Shipbuilders (84009). Ills. 2500 w. Eng News-Rec—Jan. 31, 1918. Details of work at Bristol, Pa., to house workmen and families.

MATERIALS OF CONSTRUCTION

Asphaltic Materials

Bituminous Sands of Northern Alberta (84524 N). S. C. Ells. Ills. 3000 w. Can Min Inst, Trans—1917. Undeveloped deposits and their economic importance.

Australian Hardwood

The Lightest Beams of Australian Hardwood to Carry Various Loads (84,-132 N). George Higgins. 800 w. Comwh Engr—Jan., 1918. How to ascertain the most economical sections for timber beams.

Forestry

National Forestry Scheme (84019 A). 1500 w. Colly Gdw—Jan. 11, 1918. Scheme urged by Forestry Sub-Committee of the Reconstruction Committee of the United Kingdom.

Metals

Metals and Metallurgical Research (84,-533). S. F. Kirkpatrick, in *Queens Quarterly.* 2000 w. Can Min Jl—Feb. 15, 1918. Importance of research; increased use of alloys, etc.

Natural Resources

Report of Committee XIX—On Conservation of Natural Resources (84477 N). 20 pp. A R E A, Bul—Dec., 1917.

Rubber Chemistry

Catalysts in Vulcanization (84103 B). D. Spence. 2500 w. Jl Ind & Eng Chem Feb., 1918. Account of results obtained in America.

Vulcanization of Rubber by Selenium (84104 B). Charles R. Boggs. 1200 w. Jl Ind & Eng Chem—Feb., 1918. Research work and results.

Sewer Pipe

Manufacture of Sewer Pipe (84535). Frank Coleman. Read before Can. Clay Products Assn. 4000 w. Can Engr—Feb. 21, 1918. Facts worthy consideration.

MEASUREMENT

Columns

Low Working Stress for Square-End Steel Columns is Recommended (84113). 3000 w. Eng News-Rec—Feb. 7, 1918 Final committee report of Am. Soc. of Civ. Engrs., with editorial.

Differentiation

The Application of Mechanical Differentiation to Engineering Problems (84375 B). Armin Elmendorf. 1700 w. Fkn Inst, Jl—Feb., 1918. Application to train resistance,. electric car efficiency, air resistance to flight, stresses in beams, girders and slabs, etc.

Impact

Impact—The Effect of Moving Loads on Railway Bridges (84329). W. S. Kinne. Ills. 2500 w. Wis Engr—Jan., 1918. Discussion of impact caused by unbalanced locomotive drivers. Damage caused, and how it may be avoided.

Levels

Estudio de los diversos Niveles del Ingenerio y sus perfeccionamientos (84,-576 A). J. M. Lagomasino. Ills. 4200 w. Sociedad Cubana de Ingenieros Rev types of leveling instruments used by engineers.

Surveying

Survey Monuments (84534). J. W. Pierce. Ills. 3000 w. Can Engr—Feb. 21, 1918. Permanent posts of iron, bronze, and concrete now supplanting buried tokens.

MUNICIPAL

Refuse

Refuse Disposal (84473 B). Rudolph Hering, with discussion. 21 pp. West Soc Engrs. Jl—Nov., 1917. Treatment, collection, methods of disposal and cost.

Refuse Destructor

Capacity of Toronto Refuse Destructor Exceeds Contract Provision (84115). I. S. Osborn. Ills. 3000 w. Eng News-Rec—Feb. 7, 1918. Completion and test of the Don Roadway refuse destructor at Toronto, Ont.

Operation of High Temperature Incinerator Plant at Savannah for Three Years and Nine Months (84121 A). E. R. Conaut. Ills. 1200 w. Mun Eng—Feb., 1918. Details of successful plant and its operation.

Sewage

Methods and Costs of Pressing Sewage Sludge (84266). Kenneth Allen. Extract from paper before Am. Soc of Munic. Imp. 4000 w. Eng & Con—Feb. 13, 1918. Types of presses; sludge case; cost and general considerations.

Recovery of Grease and Fertilizers from Sewage Comes to the Front (84246). 3500 w. Eng News-Rec—Feb. 14, 1918. Massachusetts Joint Investigating Board reports against applying Miles acid process at Boston.

The Electro-Chemical Sewage Treating Process as Operated at Decatur, Ill., in 1916 (84124 A). W. S. Shields. Ills. 4000 w. Mun Eng—Feb., 1918. The electrolytic lime process and its advantages for municipal work.

Sewers

Reconstruction of Queen Street Sewer, Toronto (84311). W. S. Harvey and W. G. Cameron. Ills. 4000 w. Can Engr—Feb. 14, 1918. Wooden separating troughs; details of diversion chambers; quantities and costs.

Sewer Pipe Joints (84377 B). Ills. 23 pp. Bos Soc C E, Jl—Feb., 1918. Topical discussion.

Sewers: When to Build and How to Pay (84123 A). Louis L. Tribus. 1500 w Mun Eng—Feb., 1918. Their need, design and construction, and methods of financing

Some Practical Hints on the Design and Construction of Sanitary Vitrified Pipe Sewers (84122 A). Charles E. Collins. 3000 w. Mun Eng—Feb., 1918. Important parts of design and construction.

Snow Removal

Snow Cleaning and Removal in Ottawa (84312). L. McLaren Hunter Ills. 700 w. Can Engr—Feb. 14, 1918. Methods used in handling snow in a city subject to heavy falls

ROADS AND PAVEMENTS

Asphaltic Concrete

The Saint Augustin Quebec Road (84,-[illegible]). C. A. Mullen. Ills. 2000 w. Can Engr—Feb. 7, 1918. Details of construction of road of asphaltic concrete type.

Bituminous

Bituminous Roads, Mixed and Penetration Methods (84228 C). S. R. Murray. Ills. 2300 w. Br Rds & Sts—Feb., 1918. Types of asphalt construction are considered.

Bituminous Macadam

Rhode Island Practice in Construction of Bituminous Macadam (84195). I. W. Patterson. Abstract of paper before the Providence Engrg. Soc. 3000 w. Eng & Con—Feb. 6, 1918. Details of construction

Drainage

Road Drainage (84536). J. L. Harrison. 3500 w. Can Engr—Feb. 21, 1918. Abstract of paper read before the Indiana Road School. Particularly the drainage of subgrades.

France

Condition of War Zone Roads in France (84048). W. F. Bradley. 4000 w. Auto Ind—Jan. 31, 1918. French road system and its service.

Granite Block

Approved Practice in the Construction of Granite Block Pavements (84118 A). Clarence D. Pollock. Ills. 1500 w. Mun Eng—Feb., 1918. From paper read before the Am. Assn. for Adv. of Science.

Highways

After the War, What? (84226). Franklin P. Wood. 2200 w. Br Rds & Sts—Feb., 1918. Suggests that surplus labor be utilized for paving the national highways, considering the resulting benefits

The Apache Trail, Arizona (84474). T. A. Rickard. Map & Ills. 5000 w. Min & Sci Pr—Feb. 23, 1918. Beauties of the highway from Glove to Phoenix; Roosevelt dam and reclamation project, etc.

Material

Road Material Surveys in 1915 (84,-164 N). L. Reinecke. Ills. & Maps. 185 pp. Can Dept Mines—Mem. 99. Road materials available for highways.

Pavement Financing

Financing Pavement Construction and Renewals, as Illustrated by Utica and Portland (84194). George C. Warren, in *Trans. Am. Soc. of Munic. Imp.* 3500 w. Eng & Con—Feb. 6, 1918. Systems in various cities, particularly cities named.

Paving Brick

Rattler Tests for Paving Brick of Various Depths (84227). William C. Perkins, before Am. Assn. for Adv. of Sci. 3000 w. Br Rds & Sts—Feb., 1918. Its application to the testing of 3-inch brick.

Road Building

American Road-Building Work in French War Zone Organized (84004). Robert K. Tomlin, Jr. 2500 w. Eng News-Rec—Jan. 31, 1918. Water-bound macadam the main reliance.

Lessons Learned from Road Work in War Years Will Be Permanently Helpful (84007). H. Eltinge Breed. 2500 w. Eng News-Rec—Jan. 31, 1918. Lessons learned from experience.

Traffic Census

Make $35,000 Traffic Census in Chicago Loop (84114). 1500 w. Eng News-Rec—Feb. 7, 1918. Maximum hourly record 1142 vehicles.

Wood Block

Wood-Block Pavement Failures of Southern Cities Analyzed (84244). Ills. 2000 w. Eng News-Rec—Feb. 14, 1918. Bituminous filler found to give good results.

WATER SUPPLY

Camp Supply

Details of the Design and Construction of the Water Supply of Camp Meade, Md., 79th National Army Division (84117 A). Morris Knowles. Ills. 1200 w. Mun Eng—Feb., 1918. Construction details and methods.

Chicago

Why Chicago Should Meter Its Water (84267). 3000 w. Eng & Con—Feb. 13 1918. Abstract from report by Chicago Bureau of Public Efficiency. Waste greater than any other city except Buffalo.

Dams

Earth Dam Has Screened Gravel Core and Pipe Drains (84393). L. V. Branch. Ills. 1500 w. Eng News-Rec—Feb. 21, 1918. Irrigation dam in Montana.

Will Cost Half Million to Make Austin Dam Usable (84390). 700 w. Eng News-Rec—Feb. 21, 1918. D. W. Mead advises city that the partly rebuilt dam is still defective.

The Construction of Nepaug Dam (84,-404 D). H. W. Griswold. 1600 w. N E Wr Wks Assn, Jl—Dec., 1917. Construction of a masonry dam and appurtenances.

The Design of the Diversion Conduit and Waste Works of the Richards Corner Dam at New Hartford, Conn. (84403 D). R. E. Wise, with short discussion. 2500 w. N E Wr Wks Assn, Jl—Dec., 1917. Design of the stream control conduit, the spillway, and waste channel.

Filtration

Care and Operation of Mechanical Rapid Sand Filtration Plant (84406 D). John W. Gaitenby, with discussion. 1700 w. N E Wr Wks Assn, Jl—Dec., 1917.

Grouting

Grouting of the Rock Foundations of the Dams of the Additional Water Supply of the City of Hartford (84405 D). J. E. Garratt. 3500 w. N E Wr Wks Assn, Jl—Dec., 1917. The work of testing and grouting the foundations.

Hartford, Conn.

Engineering on the Additional Water Supply for the City of Hartford (84402 D). H. W. Horne, with discussion. 2000 w. N E Wr Wks Assn, Jl—Dec., 1917. Details of extensive work including two reservoirs.

Hartford's Distribution System (84401 D). Frank Brainard, with discussion. 2200 w. N E Wr Wks Assn, Jl—Dec., 1917. Brief account of the development and matters related.

Hartford Water Works, Past and Present (84400 D). W. E. Johnson. 1600 w. N E Wr Wks Assn, Jl—Dec., 1917. Sketch of the growth and development.

New York City

The Regulation of Private Water Companies in New York City (84399 D). Delos F. Wilcox. 75 pp. N E Wr Wks Assn, Jl—Dec., 1917. Outlines conditions and the problems due to them, and the lines along which regulation is now being undertaken.

Reservoirs

The Cabbage Tree Creek Reservoir for Brisbane Water Supply (84288 A). Ills. 700 w. Engr—Jan. 25, 1918. Details of dam of cyclopean concrete costing about £172,000.

River Supply

Rivers as Sources of Water Supply (84120 A). Robert Spurr Weston. 2000 w. Mun Eng—Feb., 1918. Need of purification, sterilization, etc.

Small Works

Some Operating Problems of a Small Water Department (84408 D). Homer R. Turner, with discussion. 2500 w. N E Wr Wks Assn, Jl—Dec., 1917. Based on experience at Windsor, Conn.

Stream Pollution

Some Aspects of Stream Pollution in Connecticut (84407 D). J. Frederick Jackson. 1800 w. N E Wr Wks Assn, Jl—Dec., 1917. Sources of pollution and general principles for the prevention.

Water

Report of Committee XIII—On Water Service (84478 N). 30 pp. A R E A, Bul—Dec., 1917.

Water Softening

Improvements in Water Softening Practice on the Chicago & Eastern Illinois R. R. (84052). William Henry Hobbs. 2200 w. Ry Rev—Feb. 2, 1918. Success attained with only ordinary chemicals.

Water Waste

Water-Waste Report Written to Educate Lay Public (84116). 2500 w. Eng News-Rec—Feb. 7, 1918. Problems discussed in recent-report on "The Water-Works System of the City of Chicago."

Water-Works

Breadth of View in Water Works Design (84119 A). John W. Alvord. 1500 w. Mun Eng—Feb., 1918. Value of experience; study of water system necessary, etc.

WATERWAYS AND HARBORS

Algeria

Les Ports De L'Algérie Occidentale (84609 B). A. Pawlowski. Ills. 8900 w. Le Génie Civil—Jan. 26, 1918. One of the series of articles on French ports by the same author.

Blaye

Blaye, Port Francos-Italien (84607 B). A. Pawlowski. Ills. 1900 w. La Nature—Jan. 12, 1918. Improvements on water front of this town on Gironde river, western France.

Breakwaters

Construction of Rubble Mound Extension to Breakwater at Marquette, Mich. (84483 B). Clarence Coleman. Maps & Ills. 20 pp. Prof-Mem—Jan.-Feb., 1918. Explains conditions and describes methods.

French Seaports

American Railway Yard and Terminal Development in France Presents Many New Problems (84388). Robert K.Tomlin, Jr. 1800 w. Eng News-Rec—Feb. 21, 1918. Big construction programme at French seaports.

Havana

El Problema del Agua en la Habana (84600 A). 7500 w. Rev Sociedad Cubana De Ingenieros—Jan., 1918. Report of a Commission on improved water supply for Havana, Cuba.

Havre

Les Projets D'Extension Du Port Du Havre (84594 B). A. Dumas. Ills. Colored plate. 5200 w. Le Génie Civil—Dec. 22, 1917. New projects for harbor and waterfront development at Havre, France.

Harbors

Harbor for the River Murray Valley (84131 N). Major Johnston. 1500 w. Comwh Engr—Jan., 1918. Schemes for improvement of mouth of the largest river in Australia, and other projects.

Inland Waterways

Co-ordinated Transportation Between Railways, Ocean and Rivers (84000 A). Francis G. Newlands. 4000 w. Int Mar Eng—Feb., 1918. Plan for developing the various inland waterways of the United States.

Mississippi

The Lower Mississippi as an Arm of the Sea (84091 A). M. von Pagenhardt. 2000 w. Int Mar Eng—Feb., 1918. Its value to the new American merchant marine.

Ports

Ports of the Empire (84145 A). 1500 w. Engr—Jan. 18, 1918. Serial, 1st part. Information from report of the Dominions Royal Commission in regard to dock and harbor facilities.

United States

The Commercial Waterways of the United States (84485 B). John Mills. 2500 w. Prof-Mem—Jan.-Feb., 1918. Demand for promoting their greater utilization.

Wharves

The Rational Design of Reinforced Concrete Whaves and Jetties, with Particular Reference to Those for Wet Docks That Have a Permanent Water-Level (84558 N). W. Cleaver. Ills. 28 pp. Per-Way Inst, Jl—Dec., 1917. Read before Concrete Inst., London. Treats of details in the order of carrying out the work.

MISCELLANY

Maneuvres

Use of the General Reserve in Grand Tactic Maneuvres as Illustrated in the Russo-Japanese War (84484 B). W. A. Mitchell. Maps. 38 pp. Prof-Mem—Jan.-Feb., 1918. Study of the use of the final reserve.

Military Engineering

Liaison of Divisional Engineers With the Other Troops (84488 B). Major Rousseau. 3500 w. Prof-Mem—Jan.-Feb., 1918. Duties of engineer troops.

The Work and Experiences of the United States Engineer Troops in France (84325 A). Charles M. Clement. 8000 w. E Cb Phila, Jl—Feb., 1918. Account from one recently returned from the firing line in France.

Wolfe-Barry, Sir John

The Late Sir John Wolfe Wolfe-Barry (84286 A). 4500 w. Engng—Jan. 25, 1918. Biographical sketch.

MARINE AND NAVAL ENGINEERING

Battleships

Emergency Repairs to a Battleship (84230 A). E. E. Wilson. Ills. 2500 w. U S Nav Inst, Pro—Jan., 1918. Details of work on the "Arkansas" in substituting an electric motor for the wrecked starboard main circulating pump.

Boat Incline

Cable Inclines Carry Boats Over Illinois River Levee (84391). Ills. 1200 w. Eng News-Rec—Feb. 21, 1918. Electrically operated marine railway eliminates necessity for lock connection.

Bulkhead Doors

Watertight Doors (84095 A). I. Toro. Ills. 1800 w. Int Mar Eng—Feb., 1918. A system of doors giving communication without impairing water-tightness.

Cargo Carriers

Proposed Barge for New Waterway (83995 B). Henry J. Gillow. 3000 w. Mar Rev—Feb., 1918. Type and size of cargo carrier advocated for use on N. Y. state barge canal.

Concrete Ships

Reinforced Concrete Cargo Steamer (84093 A). Ills. 1300 w. Int Mar Eng—Feb., 1918. Plans and specifications of a 5000-ton vessel building in California.

The Fallacy of Concrete Ships (84092 A). H. A. Everett. 2000 w. Int Mar Eng—Feb., 1918. Features wherein this construction is deficient or open to serious question.

Les Constructions Navales En Béton Armé (84604 B). G. Espitallier. Ills. 4100 w. Le Génie Civil—Jan. 5, 1917. Serial, 1st part. Design and construction of reinforced concrete barges on the Lorton system, in France.

Freight Congestion

Southern Ports Will Be Used to Relieve Northern Freight Congestion (84154). 1200 w. Mfrs Rec—Feb. 7, 1918. Congestion at frozen ports will be relieved by diverting cargoes south.

Marine Engine

350 B. H. P. Kromhout Marine Engine (84027 A). Ills. 1200 w. Engr—Jan. 11, 1918. Engine operating on the two-cycle system. Details.

Motorboats

Fitting Motorboats to Transports (84553 B). A. P. Lundin. Ills. 1400 w. S A E, Jl—Feb., 1918. Need of mechanical davits, value of motor lifeboats, etc.

Pacific Transportation

Japs Gain Firmer Hold on Pacific (83996 B). R. C. Hill. 2000 w. Mar Rev—Feb., 1918. Control of rates and matters related.

Shipbuilding

Philadelphia Electric Company's Government Work (84319). Henry W. Young. Ills. 800 w. Elec Rev, Chi—Feb. 16, 1918. Electric supply for Hog Island and Delaware River shipbuilding plants.

Shipbuilding Program Analyzed (83992 B). Diagrams. 4500 w. Mar Rev—Feb., 1918. Study of plans of the Emergency Fleet Corporation, with E. N. Hurley's statement on shipping program.

Speeding Up Work at Hog Island (84239 A). 2500 w. Iron Age—Feb. 14, 1918. Conditions at this shipbuilding plant and improvements planned.

Who Will Build the Fabricated Ships? (84089 A). Robert E. Kline. 1800 w. Int Mar Eng—Feb., 1918. Suggests organized working forces from kindred industrial plants.

Shipping

Labor Factors in Our Shipping Program (84571 A). Roy Wilmarth Kelly. Ills. 3500 w. Ind Man—March, 1918. The handicap of enormous labor turnover.

Shipyards

Capital Now Flows to Shipyards (83993 B). Cuy F. Creveling. Ills. 2500 w. Mar Rev—Feb., 1918. Shipbuilding in America. Future financial support assured.

New Shipyards Built on Canadian Pacific Coast (84392). R. Mackay Fripp. Ills. 1200 w. Eng News-Rec—Feb. 21, 1918. Types of plants for both wooden and steel vessels in British Columbia.

Tremendous Cost of Hog Island Plant (84111 A). 2500 w. Iron Age—Feb. 7, 1918. Critical discussion of the new shipyards of the U. S. Government.

Standardization

Marine Engineers Discuss Standardization (84045). Ills. 2500 w. Auto Ind—Jan. 31, 1918. Considers standardized fittings and construction of one-design vessels.

Submarines

Offensive Against the Submarine (84326 A). Joseph A. Steinmetz. Ills. 5000 w. E Cb Phila, Jl—Feb., 1918. Protection against submarine attack; mines and torpedoes for naval operations, etc.

Terminals

Transportation Efficiency for the War (84004 A). E. Amberg. Ills. 1500 w. Int Mar Eng—Feb., 1918. Development of terminal facilities. What New Orleans has accomplished.

U. S. Navy

Electricity as Applied in the U. S. Navy (84366). Ills. 3000 w. Power—Feb. 10, 1918. Various electrical appliances on a modern battleship.

MINING AND METALLURGY

BASE METALLURGY

Arkansas

The North Arkansas Zinc and Lead Field (84304). Tom Shiras. Ills. 1600 w. Eng & Min Jl—Feb. 16, 1918. Recent progress in metallurgical processes and developments in the sulphide zone.

Copper

The Physical Properties of Copper and the Factors by Which They Are Affected (84070 A). Paul D. Merica. Ills. 4000 w. Met & Chem Eng—Feb. 1, 1918. Serial, 1st part. Compilation of available information.

Copper Recovery

Sulphur Dioxide Method for Determining Copper Minerals in Partly Oxidized Ores (84278 A). Charles E. Van Barneveld and Edmund S. Leaver. 3000 w. Met & Chem Eng—Feb. 15, 1918. Rapid method.

Indo-China

Zinc-Smelting Possibilities in Tonkin, Indo-China (84305). Abstract of paper by A. Lochard. 2500 w. Eng & Min Jl—Feb. 16, 1918. Review of conditions where natural resources promise profitable development.

Lead

The Kingdon Lead Mine (84509 N). John E. Hardman. Ills. 2000 w. Can Min Inst, Trans—1917. History of this property.

Lead and Zinc

Le Lavage Des Minerais De Plomb Et De Zinc (84606 B). Ills. 1500 w. Le Génie Civil—Jan. 12, 1918. Serial, 1st part. Treatment of lead and zinc ore by washing.

Zinc

Recovery of Spelter and the Treatment of Retort Residues (84073 A). Edward Mackay Johnson. 3000 w. Met & Chem Eng—Feb. 1, 1918. Information on the recovery and sampling of spelter, with cost figures on the jigging and smelting of retort residues.

The Hydrometallurgy and Electrolytic Precipitation of Zinc (84234 N). 21 pp. Sch Mines & Met, Mo., Bul—Aug., 1917. Information available and results of experiments.

Fine - grinding and Porous - briquetting of the Zinc Charge (84363 D). Woolsey McA. Johnson. 1500 w. A I M E, Bul—Feb., 1918. Necessary characteristics of the zinc-retorting charge showing how the coal can be reduced.

Zinc Ferrate

[illegible] Zinc Ferrate (84508 N). [illegible], G. Murray, and D. McIntosh. [illegible] Can Min Inst, Trans —1917. Explanation of the low solubility of some roasted zinc ores in dilute sulphuric acid.

COAL AND COKE

Benzols

Comparative Values of Coke Oven Crude Benzols (84432 A). B. W. Haigh and H. Lamb. 3500 w. Colly Gdn—Feb. 1, 1918. From paper read before the Coke Oven Mgrs. Assn. Research work and results.

Blacksmithing

Blacksmithing at Coal Mines (84301). J. F. Springer. Ills. 5000 w. Cl Age—Feb. 16, 1918. Methods of annealing steels; tempering of bits, etc.

Breaker

The Drifton Breaker (84338 D). Effingham P. Humphrey. Ills. 3800 w. A I M E, Bul—Feb., 1918. Rebuilding and remodeling of the first iron breaker erected in the anthracite region.

Canada Fuels

The Fuels of Canada (84044). B. F. Haanel. 6000 w. Can Engr—Jan. 31, 1918. Need of bettering the fuel situation in certain sections.

Carbonization

The Low Temperature Carbonization of Coals (84530 N). J. L. Stevens. 5000 w. Chem Eng & Min Rev—Jan., 1918. Serial, 1st part. Reviews attempts made and suggests lines for future development.

Coal

Coal and Its Selection (84000). Walter N. Polakov. 4500 w. Pwr Pt Eng—Feb. 1, 1918. Coal formation and qualities, proper selection and use.

Coal Fields

Coal Field Surveys in New Zealand (84018 A). 1500 w. Colly Gdn—Jan. 11, 1918. Information from eleventh annual report of the Mines Department.

Coal Plant

Preparing No. 3 Pocahontas Coal (84,209). Richard G. Miller. Ills. 1000 w. Cl Age—Feb. 9, 1918. Type of plant and machinery adopted; conveying machinery described.

Coal Problem

Better Handling of Coal Problem Needed (84212). 2000 w. Elec Wld—Feb. 9, 1918. Essentials to meet the present enormous fuel requirements.

Coal Situation

Rate Increases to Follow High Cost of Coal (84061). 2500 w. Elec Wld—Feb. 2, 1918. Serial, 1st part. Phases of the critical coal situation.

Some Why's of the Coal Shortage (84,540). 2500 w. Power—Feb. 26, 1918. Enumerates some of the causes.

While the Idle Millions Shiver (84066). Ills. 1200 w. Power—Feb. 5, 1918. Conditions at Perth Amboy, N. J., causing great suffering in New York City.

Coal Storage

Modern Methods for the Storage of Coal (84021 A). George Frederick Zimmer. 3 plates. 5000 w. Engng—Jan. 11, 1918. Serial, 1st part. Need of storage, causes of deterioration, methods, etc.

Coal Tests

University of Illinois Coal Tests (84,180 A). 2500 w. Ry Mech Engr—Feb., 1918. Comparative high and medium capacity performance of various grades in locomotive service.

Coal Trade

The Future of the Coal Trade of the Empire (84523 N). Allan Greenwell, with discussion. 12 pp. Can Min Inst, Trans —1917. Effects of the war, and general review.

Coke Ovens

Modern Rectangular Coke-Oven Plant (84451). Dever L. Ashmead. Ills. 2000 w. Cl Age—Feb. 23, 1918. Modern plant with details of mechanical apparatus.

Preventing Leakage in Coke Ovens (84016 A). H. Grahn in *Glückauf*. Ills. 6000 w. Colly Gdn—Jan. 11, 1918. Methods of preventing losses from leakage.

Culm

Reclaiming the Culm Pile (84060). G. D. Evans. Ills. 1000 w. Cl Age—Feb. 2, 1918. One of many plants now shipping to market.

Fuel

A Revolutionizing Coal Discovery Announced from New York (84152). 2000 w. Mfrs Rec—Feb. 7, 1918. Concerning a new process for treating bituminous coal, so that for fuel purposes it becomes equivalent to anthracite.

Gatehouse

Efficient Coal-Mine Gatehouse (84210). R. M. Magraw. Ills. 1000 w. Cl Age—Feb. 9, 1918. Describes a check cabin and features of checking system.

Pulverized Coal

Utilization of Pulverized Coal (84001). H. G. Barnhurst. 3000 w. Pwr Pt Eng—Feb. 1, 1918. Methods of preparing and handling.

Roof Supports

Supporting the Roof in Coal Mines (84453). R. D. Brown. Ills. 3000 w. Cl Age—Feb. 23, 1918. Serial, 1st part. Present article considers temporary and permanent wood supports.

Spontaneous Combustion

Heating of Coal in Piles (84339 D). C. M. Young. 600 w. A I M E, Bul—Feb., 1918. Investigation of ways of preventing heating in storing coal.

Switzerland

The Coal and Electricity Question in Switzerland (84024 A). 1700 w. Engr—Jan. 11, 1918. Explains the serious situation due to German influence.

Thawing

Dry Process of Thawing Coal (84452). Ills. 1100 w. Cl Age—Feb. 23, 1918. The car is placed in a building in which hot air is circulated.

Washing

Coal Washing (84141 A). T. J. Drakeley. From paper before Manchester Geol. & Min. Soc. 8500 w. Colly Gdn—Jan. 18, 1918. Theory and practice, efficiency, and general conclusions.

GEOLOGY

British Columbia

Gneissic Galena Ore from the Slocan District, British Columbia (84330 B). W. L. Uglow. Ills. 4500 w. Ec-Geol—Dec., 1917. General geology; the ore bodies, their occurrence, structure, origin, etc.

Coal

Coal—Its Origin and Composition (84,303). H. B. Miller. 2200 w. Cl Age—Feb. 16, 1918. Accepted theories of geologists and related information.

Korea

Geology and Ore Deposits of the Collbran Contact of the Suan Mining Concession, Korea (84480 B). D. F. Higgins. Ills. 34 pp. Ec-Geol—Jan., 1918. Phenomena associated with intrusion, metomorphism and ore deposition.

Magnetites

Some Features of Magnetic Surveys of the Magnetite Deposits of the Duluth Gabbro (84481 B). T. M. Broderick. Maps & Ills. 14 pp. Ec-Geol—Jan., 1918. Outlines methods used and some results obtained.

The Relation of the Titaniferous Magnetites of Northeastern Minnesota to the Duluth Gabbro (84331 B). T. M. Broderick. Ills. 34 pp. Ec-Geol—Dec., 1917. Types of magnetic ore within the gabbro and their origin.

Manchuria

Coal and Iron Deposits of the Pen-hsi-hu District, Manchuria (84341 D). C. F. Wang. Ills. 28 pp. A I M E, Bul—Feb., 1918. Describes the district, geology, deposits, development, etc.

Mesabi Range

Recent Geologic Developments on the Mesabic Iron Range Minnesota (84431 N). J. F. Wolff. Ills. 29 pp. L. S. Min Inst, Pro—1917. Sub-divisions of the iron formation, with discussion of the relations of the ore-bodies to the folding and fracturing.

Mineragraphy

Notes on the Technique of Mineragraphy (84332 B). W. L. Whitehead. Ills. 20 pp. Ec-Geol—Dec., 1917. Experience in the preparation and study of polished section of ores.

Ontario

Espanola District, Ontario (84165 N). Terence T. Quirke. Ills. & Maps. 85 pp. Can Dept Mines—Mem. 102. Account of the geology.

Ore Deposits

Ore Deposits of the Yellow Pine Mining District, Clark County, Nevada (84,360 D). Fred A. Hale, Jr. Map & Ills. 18 pp. A I M E, Bul—Feb., 1918. Describes the most prominent geologic features, with special reference to those of economic importance. Oxidized lead-zinc deposits, copper-gold, with platinum metals; also silver.

The Evolution of Ore Deposits from Igneous Magmas (84188 A). W. H. Goodchild. 7500 w. Min Mag—Jan., 1918. Serial, 1st part. Principles governing the segregation of ore deposits from rock magmas.

Origin of Ores

Some Chemical Experiments Bearing on the Origin of Certain Uranium-Vanadium Ores (84482 B). Frank B. Notestein. 14 pp. Ec-Geol—Jan., 1918. Investigations of certain natural solvents and precipitants of vanadium and uranium.

Phosphate

Phosphate in Egypt (84358 D). E. Cortese. Map. 1500 w. A I M E, Bul—Feb., 1918. Principal features of beds examined.

Sudbury Ores

Genesis of Sudbury Nickel-Copper Ores as Indicated by Recent Explorations (84,361 D). Hugh M. Roberts and Robert Davis Longyear. Maps & Ills. 30 pp. A I M E, Bul—Feb., 1918. Results of exploration of the Sudbury district of Ontario.

IRON AND STEEL

British Columbia

Opportunities for the Establishment of an Iron and Steel Industry in British Columbia (84519 N). Robert R. Hedley, with discussion. 3000 w. Can Min Inst, Trans—1917. Reviews conditions.

Canada

The Present Position and Future of the Iron and Steel Industries in Canada (84518 N). Corbett F. Whitton, with discussion. 56 pp. Can Min Inst, Trans —1917. Analysis of the present situation, particularly the commercial and manufacturing side.

Ferro-Uranium

Preparation of Ferro-Uranium (84022 A). 2500 w. Engng—Jan. 11, 1918. Editorial on the paper of H. W. Gillett and E. L. Mack.

Fuels

Coke as Blast Furnace Fuel (84371 A). Abstract of paper by G. W. Hewson, with discussion. 4500 w. Colly Gdn—Jan. 25, 1917. Characteristics of fuel desirable for blast furnaces, etc.

Lake Superior Districts

Reminiscences of the Development of the Lake Superior Iron Districts (84423 N). John M. Longyear. 13 pp. L S Min Inst, Pro—1917.

Minnesota

Manganiferous Iron Mining in the Cuyuna District, Minnesota (84215). P. M. Ostrand. Ills. 4000 w. Eng & Min Jl—Feb. 9, 1918. Production and methods of mining.

Slag

The Viscosity of Blast-Furnace Slag and Its Relation to Iron Metallurgy, Including a Description of a New Method of Measuring Slag Viscosity at High Temperatures (84491 N). Alexander L. Feild. Ill. 33 pp. Faraday Soc, Trans—Dec., 1917.

Tilting Furnaces

Tilting Metal Mixers and Steel Furnaces (84257 A). H. Stonewall Jackson. 2000 w. Ir & Cl Trds Rev—Jan. 25, 1918. Abstract of paper read before Cleveland Instn. of Engrs., with short discussion. Progress in design.

MINE OPERATION

Australia

The Broken Hill South Mine (84187 A). W. E. Wainwright and P. H. Warren. Ills. 2500 w. Min Mag—Jan., 1918. One of the most important mines on the Barrier Range. High-grade lead-zinc-silver ore.

Blasting

Blasting Explosives and Their Accessories (84427 N). Charles S. Hurter. Ills. 50 pp. L S Min Inst, Pro—1917. Their nature, detonation, etc.

Use of Powder in Opencut Blasting (84464). E. S. Jacobson. 2200 w. Eng & Min Jl—Feb. 23, 1918. Practical suggestions, based on experience.

Crushing Plant

Crushing Plant at Brier Hill Shaft (84425 N). Floyd L. Burr. Ills. 10 pp. L S Min Inst, Pro—1917. Construction and equipment.

Electric Power

Electrical Power in Mining on the Menominee Range (84422 N). Charles Harger. Ills. 13 pp. L S Min Inst, Pro—1917. Three plants are described.

Laws

Siamese Mining Laws (84189 A). 2000 w. Min Mag—Jan., 1918. Latest enactments regulating mining in Siam.

Methods

Methods of Mining at the Chapin Mine (84418 N). W. C. Gordon. 16 pp. L S Min Inst, Pro—1917. Brief description of the geology and methods of mining.

Methods of Mining in Crowsnest Pass District, Alberta (84520 N). Raoul Green. Ills. 2200 w. Can Min Inst, Trans—1917. Systems depending on the geological and physical features.

Mining Methods at the Magpie Iron Mine (84517 N). A. Hasselbring. Ills. 2000 w. Can Min Inst, Trans—1917. Siderite, in Ontario, mined and made into merchantable ore by roasting.

Mining Methods in the Iron River District of Michigan (84419 N). Rudolph Ericson. 2500 w. L S Min Inst, Pro—1917. Brief account of methods at the various mines.

The Ore-Mining Method Used at the Raimund Division, Birmingham District, Alabama (84430 N). Gerald G. Dobbs. Ills. 17 pp. L S Min Inst, Pro—1917. Location, description and methods of mining.

Mine Lights

Electric Lamps in Nongaseous Mines (84059). George H. Deike. Abstract of paper before the Natl. Safety Council. 2200 w. Cl Age—Feb. 2, 1918. Reasons why electric lamps are safer for all mines.

Mine Power

Economy of Electricity Over Steam for Power Purposes In and About Mines (84340 D). R. E. Hobart. Ills. 2500 w. A I M E, Bul—Feb., 1918. Tests show saving by electrification.

Mine Signalling

Signalling System of Bengal Mine, Palatka, Michigan (84428 N). A. H. MacGregor. Ills. 10 pp. L S Min Inst, Pro—1917. Requirements, with details of system and its working.

Pit Rails

Choosing and Laying Pit Rails (84433 A). From *Glückauf*. Ills. 2800 w. Colly Gdn—Feb. 1, 1918. Considers rails, sleepers, laying, switches and turntables.

Power Plants

Mine Plant Saves Forty-five Tons of Coal Per Day (84541). Ills. 1000 w. Power—Feb. 26, 1918. Installation of a new boiler plant reduces fuel consumption and increases mine capacity.

Quarries

Establishing a Municipal Stone Quarry (84130 N). Arthur Farrer. Ills. 1500 w. Comwh Engr—Jan., 1918. Experiences in establishing a municipal quarry and stone-breaking plant for road-making purposes in Ballarat, Australia.

Shaft Lining

Relining a 20-Ft. Diameter Shaft (84,256 A). G. B. Tristram. Ills. 2000 w. Ir & Cl Trds Rev—Jan. 25, 1918. Details of the work.

Shafts

Equipping and Sinking the No. 1 Shaft at the Holmes Mine (84424 N). Lucien Eaton. Ills. 18 pp. L S Min Inst, Pro—1917. Detailed description.

Shift Boss

Qualifications and Duties of a Shift Boss (84467). 2000 w. Eng & Min Jl—Feb. 23, 1918. Address by Joseph P. Hodgson to mine foremen and department heads of the Copper Queen mines.

Stoping

Stoping to Branched Raises (84429 N). F. W. Sperr. Ills. 1500 w. L S Min Inst, Pro—1917. Explains use of branched raises for sublevel stoping.

Yukon

Further Notes on Yukon Mining Problems (84510 N). Henry M. Payne. Ills. 19 pp. Can Min Inst, Trans—1917. Thawing methods and results.

MINES AND DISTRICTS

Calumet and Hecla

Notes on the Calumet & Hecla Mine Fire (84426 N). John Knox, Jr. 6 pp. L S Min Inst, Pro—1917. Account of the fire and conditions in connection.

The Founding of the Calumet & Hecla Mine, 1866–1916 (84421 N). 3000 w. L S Min Inst, Pro—1917. Early history of this mine.

Canada

Summary Report of the Mines Branch of the Department of Mines for the Calendar Year Ending December 31, 1916 (84471 N). Can Dept Mines—No. 454.

The Fuels and Waterpowers of Canada. A Consideration of Their Proper Spheres of Usefulness (84537). A. S. L. Barnes. 3000 w. Can Engr—Feb. 21, 1918. Fundamental principles for their conservation and use.

MINOR MINERALS

Magnesite

The Development of Canadian Magnesite (84513 N). Harold J. Roast, with discussion. Ills. 10 pp. Can Min Inst, Trans—1917. Deposits and manufactured products.

Magnesium

Magnesium—Its Properties, Manufacture and Uses (84526 N). J. [illegible] King. 3000 w. Can Min Inst, Trans—1917. Summary of available information.

Manganese

The Utilization of Manganese Ores in Sweden (84249 A). Joh. Harden. 2500 w. Elec'n—Jan. 25, 1918. Methods of smelting; furnace types; methods of using the alloy, etc.

Molybdenite

The Concentration and Marketing of Canadian Molybdenite (84505 N). H. H. Claudet, with discussion. 4500 w. Can Min Inst, Trans—1917. Film-flotation and other modern methods of treatment.

Nickel

The Metallurgy of Nickel (84365). F. H. Mason. 3500 w. Min & Sci Pr—Feb. 16, 1918. Abstract of report of the Royal Ontario Nickel Commission.

Nitrates

The Chilean Nitrate Industry (84357 D). Allen H. Rogers and Hugh R. Van Wagenen. Ills. 18 pp. A I M E, Bul—Feb., 1918. Its importance, deposits, origin of nitrate, mining and transportation methods, extraction plants, etc.

Potash

I. Cleaning Blast-Furnace Gas for Boilers and Stoves. A. Lennox Leigh. II. The Commercial Aspects of the Recovery of Potash in the Manufacture of Pig Iron. Kenneth M. Chance, with short discussion (84149 A). 7000 w. Ir & Cl Trds Rev—Jan. 18, 1918. Read before the Cleveland Instn of Engrs. Special reference to the recovery of potash.

Effect of Coal Ash on the Liberation and Nature of Cement-Mill Potash (84,101 B). N. S. Potter, Jr. and R. D. Cheesman. 1800 w. Jr Ind & Eng Chem—Feb., 1918. Research work and results.

Sources of Potash (84599 A). T. E. Thorpe. 2000 w. Nature—Jan. 3, 1918. Distribution of potash in Germany, Spain, Abyssinia and the Caspian region.

Potash, Its Present and Other Possible Sources (84516 N). C. W. Drury. 29 pp. Can Min Inst, Trans—1917. Review with conclusions.

Recovery of Potash from Blast Furnace Gases (84394 N). R. A. Berry and D. N. McArthur, with discussion. 28 pp. West Scot I & S Inst, Jl—Oct.-Nov., 1917. Sources of supply, especially industrial by-products.

Recovery of Potash from Blast -Furnace Gases (84255 A). R. A. Berry and D. N. McArthur. 3500 w. Ir & Cl Trds Rev—Jan. 25, 1918. Abstract of paper joint meeting of West of Scot. Ir. & St. Inst. and Soc Chem. Ind. Sources of potash, losses, etc.

Some Methods of Analysis for Nebraska Potash Salts and Brines (84105 B). A. H. McDowell. 1500 w. Jl Ind & Eng Chem—Feb., 1918. Gives methods developed.

The Direct Heat Treatment of Cement Mill Dust to Increase Its Water Soluble Potash Content (84100 B). Albert R. Merz. 2500 w. Jl Ind & Eng Chem—Feb., 1918. Methods of recovery.

The Extraction of Potash and Other Constituents from Sea Water Bittern (84099 B). Joel H. Hildebrand. Ills. 6500 w. Jl Ind & Eng Chem—Feb., 1918. Methods of recovery; experiments, proposed process.

Pyrite

Pyrite and Pyrrhotite Resources of Ducktown, Tenn. (84350 D). Joseph H. Taylor. 2000 w. A I M E, Bul—Feb., 1918. Deposits and their development. Valuable source of supply of sulphuric acid.

Refractories

Refractory Materials in Canada (84,512 N). N. B. Davis. 10 pp. Can Min Inst, Trans—1917. Distribution of raw materials, etc.

Sulphur

Use of Sulphur in Fertilization (84155). Courtenay De Kalb. 1500 w. Mfrs Rec—Feb. 7, 1918. Conditions for success in its use.

Zirconium

Properties and Uses of Zirconium and Its Compounds (84306). Excerpt from paper by H. G. Meyer. 1800 w. Eng & Min Jl—Feb. 16, 1918. Discusses properties and uses in manufacture of zirkite bricks and laboratory ware.

OIL AND GAS

Alabama

Possible Oil and Gas Fields in the Cretaceous Beds of Alabama (84355 D). Dorsey Hager. Map. 2200 w. A I M E, Bul—Feb., 1918. Outlines four favorable areas.

Oil

Oil and Its Applications (84258 A). Abstract of lecture by A. F. Baillie before Gloucester Engng. Soc. 2000 w. Ir & Cl Trds Rev—Jan. 25, 1918. Applications and advantages in comparison with coal.

Oil Lands

Methods of Valuing Oil Lands (84353 D). M. L. Requa. 20 pp. A I M E, Bul—Feb., 1918. Methods adopted by the Committee of the Independent Oil Producers' Agency.

Oil Prospecting

Principles and Problems of Oil Prospecting in the Gulf Coast Country (84354 D). W. G. Matteson. Ills. 40 pp. A I M E, Bul—Feb., 1918. The extent, history, topography and physiography, stratigraphy, etc., of the Gulf Coast Plain. Methods of surveying, prospecting and developing.

Oils

A Comparison of Linseed Oil and Lumbang Oils as Paint Vehicles (84190 N). R. H. Aguilar. Ills. 2000 w. Phil Jl Sci—Sept., 1917. Comparative tests on the properties.

Oil Wells

Some New Methods for Estimating the Future Production of Oil Wells (84356 D). J. O. Lewis and Carl H. Beal. 28 pp. A I M E, Bul—Feb., 1918. Discusses some new methods for estimation of production.

Ontario

Oil Prospecting in Southwestern Ontario (84532). M. Y. Williams. Maps. 1200 w. Can Min Jl—Feb. 15, 1918. Suggestions to prospectors.

Rumania

The Petroleum Industry of Rumania (84143 A). 2500 w. Engng—Jan. 18, 1918. Editorial review of a paper by T. S. Masterson.

Toluol

Intensive Toluol Production (84075 A). Frank E. Lichtenthaeler. Ills. 6500 w. Met & Chem Eng—Feb. 1, 1918. Serial, 1st part. Proposed improvements in the absorbing and stripping process.

Tuluol Recovery and Standards for Gas Quality (84102 B). R. S. McBride. 3000 w. Jl Ind & Eng Chem—Feb., 1918. Present standards of gas quality and conditions; influence of tuluol recovery on quality; recommendations.

ORE DRESSING

Amalgamation

Amalgamation and Roasting Practice in Gold Coast Colony (84465). Paul T. Bruhl. 2500 w. Eng & Min Jl—Feb. 23, 1918. Practice in Africa. Correct procedure under varying conditions.

Ball-Milling

Notes on Theory and Practice of Ball-Milling, Particularly Peripheral Discharge Mills (84342 D). Pierre R. Hines. Ills. 3300 w. A I M E, Bul—Feb., 1918. Practical operation, particularly of the diaphragm type.

Copper-Leaching

Copper-Leaching at Ajo (84207). Courtenay De Kalb. Ills. 6000 w. Min & Sci Pr—Feb. 9, 1918. Metallurgical difficulties overcome; details of treatment; practical results.

Copper Oxide

Sulphur and Copper Oxide Determination (84466). C. G. Maier. 1600 w. Eng & Min Jl—Feb. 23, 1918. Analytical determination of copper present in the form of oxidized minerals in ores or mill products.

Decantation

Countercurrent Decantation (84511 N). L. B. Eames. 18 pp. Can Min Inst, Trans—1917. Principles and characteristics of the process, mechanical problems, and details of Hollinger plant.

Flotation

Canadian Wood Oils for Ore Flotation (84502 N). C. S. Parsons and R. E. Gilmore. 55 pp. Can Min Inst, Trans—1917. Investigations and satisfactory results.

Flotation License of Minerals Separation North American Corporation (84307). 2500 w. Eng & Min Jl—Feb. 16, 1918. The license agreement is reviewed.

Flotation of Chalcopyrite - Pyrrhotite Ore (84208). Will H. Coghill. 1500 w. Min & Sci Pr—Feb. 9, 1918. Tests on Oregon ores; results.

Present Flotation Practice on Cobalt Ores (84501 N). J. M. Callow and E. B. Thornhill. 1800 w. Can Min Inst, Trans—1917. Shows adaptability of flotation to low-grade ores and mill products.

Sea-Water for Flotation (84050). 900 w. Min & Sci Pr—Feb. 2, 1918. Saline waters, without oil, will float sulphides.

Scientific Nominalism and Flotation Physics (84049). Dudley H. Norris. 4800 w. Min & Sci Pr—Feb. 2, 1918. Science dominated by nominalism; application to flotation; Norris patent.

Heap-Leaching

Some Experiments in Heap-Leaching Copper Ores (84033). George D. Van Arsdale. Ills. 7000 w. Eng & Min Jl—Feb. 2, 1918. Results of experiments to determine a successful method for treating porphyry ores containing less than 1¼ per cent. copper.

Milling Practice

Notes on Milling Practice at the McIntyre Mine, Porcupine, Ont. (84503 N). A. Dorfman. 17 pp. Can Min Inst, Trans—1917. Classes of ore with history of experiments resulting in successful methods.

Separation

A New Method of Separating Materials of Different Specific Gravities (84343 D). Thomas M. Chance. Ills. 1500 w. A I M E, Bul—Feb., 1918. Describes an agitation method.

Smelting

The Partridge Smelting Furnace (84514 N). Allen R. Partridge. Ills. 1700 w. Can Min Inst, Trans—1917. Its construction and adaptability.

PRECIOUS METALLURGY

Cobalt, Ont.

Milling Practice at the Buffalo Mines, Cobalt, Ont. (84500 N). Robert E. Dye. 4500 w. Can Min Inst, Trans—1917. The methods employed and what they accomplish.

Precipitation

Sodium Sulphide Precipitation of Silver at the Nipissing Mine (84499 N). R. B. Watson. 1500 w. Can Min Inst, Trans—1917. Its use and cost.

Russia

Irtysh Corporation Developments in Siberia and the Russian Internal Situation (84216). 6000 w. Eng & Min Jl—Feb. 9, 1918. Leslie Urquhart reviews Russia's present internal condition and the important mining and smelting operations in the Altai region.

Silver

Notes Concerning Local Treatment for Certain West Kootenay Silver Ores (84504 N). Francis A. Thomson. 1500 w. Can Min Inst, Trans—1917. Results of tests on silver ores.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION

Light Traffic

Les Chemins De Fer A Faible Trafic (84596 B). Claise. 4000 w. Le Génie Civil—Dec. 29, 1917. Suggestions for conducting railways of light traffic after the war. Reducing the working force and operating expenses.

Signaling

Interborough Rapid Transit Electro-Pneumatic Plant (84310). Charles McGregor. Ills. 3000 w. Ry Sig Engr—Feb., 1918. Arrangement of signals and interlocking to care for three track junction in connection with the extension of N. Y. subway system.

Electrical Signalling and Control on Railways (84493 N). C. M. Jacobs. Ills. 3500 w. Instn E E—Jan. 15, 1918. Indications, track circuit, single line working, power, and limitations.

Physically and Mentally Protected (84076 A). Ills. 1200 w. Ry & Loc Eng—Feb., 1918. Action of stop signals for train protection.

Snow

Pulling the Chicago Terminals Out of the Snow (84270). Ills. 1500 w. Ry Age—Feb. 15, 1918. Work of restoring traffic after the January blizzard.

Train Movement

Headway or Spacing of Trains (84081 A). Walter V. Turner. 1800 w. Ry & Loc Eng—Feb., 1918. Systems in use.

MOTIVE POWER AND EQUIPMENT

Air Brakes

Cleaning and Lubricating Brake Cylinders (84080 A). 1400 w. Ry & Loc Eng—Feb., 1918. Directions.

Ambulance Train

British Ambulance Train for American Wounded (84161). Ills. 1000 w. Ry Age—Feb. 8, 1918. The Midland Ry. of England has built a 16-car train.

Back Pressure

La Contre Vapeur (84589 C + D). A. Herdner. Ills. 110 pp. 32,000 w. Bul Soc Ingénieurs Civils De France—June-Sept., 1917. Comprehensive treatment of back pressure in locomotive cylinders, its use for braking, etc.

Cars

A 100-Ton Coal Car for the N. & W. (84183 A). B. W. Kadel. Ills. 1000 w. Ry Mech Engr—Feb., 1918. Details of construction.

C. M. & St. P. Fifty-Ton Gondolas (84185 A). Ills. 500 w. Ry Mech Engr—Feb., 1918. Steel center sill designed to resist buffing stresses only.

Hopper Bottom Gondola Cars for C. M. & St. P. (84028). Ills. 500 w. Ry Age Gaz—Feb. 1, 1918. Composite construction with heavy steel center sill.

Norfolk & Western Hopper Car of 100 Tons Capacity (84160). B. W. Kadel. Ills. 1000 w. Ry Age—Feb. 7, 1918. All-steel construction using six-wheel trucks. Load 77 per cent. of gross weight.

Electric Locomotives

Most Powerful Electric Passenger Locomotives (84032). Ills. 1200 w. Ry Age—Feb. 1, 1918. New power for Chicago, Milwaukee & St. Paul.

New Passenger Locomotive for the St. Paul (84054). Ills. 1000 w. Elec Ry Jl—Feb. 2, 1918. Mechanical features; motors, control, and auxiliaries.

Pennsylvania Electric Locomotive (84182 A). Ills. 2500 w. Ry Mech Engr—Feb., 1918. Details of running gear and electrical equipment.

The New Passenger Locomotives of the Chicago, Milwaukee, and St. Paul Railway (84126 A). W. R. Stinemetz. Ills. 1000 w. Elec Jl—Feb., 1918. Interesting features of the most powerful locomotives in passenger service.

Electrification

See Iron Wire, under Electrical Engineering, *Transmission and Distribution.*

Fuel

Pulverized Fuel for Locomotives (84522 N). J. S. Coffin, Jr. Ills. 4500 w. Can Min Inst, Trans—1917. History, equipment, operation, tests and conclusions.

Who Wastes the Fuel? (84158) 2000 w. Ry Age—Feb. 8, 1918. Showing that responsibility and shortcomings extend from the president to the water boy.

Locomotive Design

Modern Tendencies in Locomotive Design (84051). Louis E. Endsley. 1500 w. Ry Rev—Feb. 2, 1918. Leading factors and developments.

Locomotives

N. Y. C. 4-8-2 Type Freight Locomotives (84179 A). Ills. 1500 w. Ry Mech Engr—Feb., 1918. Details and dimensions.

Santa Fe 2-8-2 Type Locomotive (84181 A). Ills. 1000 w. Ry Mech Engr—Feb., 1918. Increased power capacity as compared with an earlier class of same type.

Some British Locomotives of 1917 (84026 A). Ills. 2500 w. Engr—Jan. 11, 1918. New engines and modifications of existing engines.

Materials

Railway Materials and the War (84265 A). R. J. Pike. 2500 w. A E R A—Jan., 1918. Economy the only solution of the problem.

Rail Return

Le Conducteur De Retour Du Courant Alternatif (84597 B). 4000 w. Le Génie Civil—Dec. 29, 1917. Rail return for A. C. railways. Feeders, bonding, etc. Experiences on French railways.

Regenerative Braking

Note Sur Le Démarrage Automatique Des Moteurs (84602 B). P. Legrand. Ills. 3500 w. L'Industrie Électrique—Jan. 25, 1918. Automatic braking for A. C. and D. C. motors. French schemes of wiring and motor control.

Tank Cars

The Tank Car in Interchange (84184 A). E. S. Way. Ills. 1500 w. Ry Mech Engr—Feb., 1918. Characteristics of the different types under M. C. B. specifications.

Wheel Contacts

Wheel Contacts on Railheads (84335 B). George H. Barbour, with discussion. Ills. 34 pp. Engrs Soc W Penn, Pro—Nov., 1917. Revision of calculations given in April meeting, and published in July, 1917, Proceedings.

PERMANENT WAY AND BUILDINGS

British Railways

The Modern British Railway: Its Inception, Construction and Maintenance (84560 N). T. H. Seaton. 13 pp. Per-Way Instn, Jl—Dec., 1917. Economic considerations.

Clay Formation

Methods of Dealing with Railway Formation in Clay Cutting (84561 N). J. H. Chappell. Ills. 1500 w. Per-Way Instn, Jl—Dec., 1917. Methods described.

Combined System

Das neue vereinigte Reibungs- und Zahnbahn-System Peter (84601 B). S. Abt. Ills. 1800 w. Schweizerische Bauzeitung—Jan. 5, 1918. Serial, 1st part. Combined adhesion and rack rail electric railway—Peter System.

Rails

The Internal Strains in Steel Rails (84233 N). James E. Howard, with discussion. 25 pp. N E Rd Cb, Pro—Jan. 8, 1918. Investigations, and information concerning strains rails must sustain.

Spikes

Pennsylvania System Rejects Screw Spikes (84159). Ills. 5500 w. Ry Age—Feb. 8, 1918. Action taken after exhaustive experiments at two points for eight years.

Terminals

The Wabash-Pittsburgh Terminal Investigation (84271). 5000 w. Ry Age—Feb. 15, 1918. Excerpts from report of the Interstate Commerce Commission.

Tool Rooms

The Many Advantages of a Manufacturing Tool Room to a Modern Railroad Shop (84169 A). J. H. Painter, with discussion. Ills. 8 pp. S & S W Ry Cb, Pro—Jan., 1918.

Track Circuits

Track Circuiting of Railways (84559 N). H. Cowan. 13 pp. Per-Way Instn, Jl—Dec., 1917. The essential features of track circuits; effect of water, precautions during repairs, etc.

Track

A Scientific Study of Railway Track Under Load (84443). Ills. 4000 w. Ry Age—Feb. 22, 1918. Progress report on investigations and tests extending over five years.

Report of Committee V—On Track (84475 N). Ills. 21 pp. A R E A, Bul—Dec., 1917.

ROADS AND PROJECTS

Australia

The Trans-Continental Railway of Australia (84030). Map and Ills. 2500 w. Ry Age—Feb. 1, 1918. Difficulties in constructing the Kalgoorlie-Port Augusta railway.

China

The Economics of the Chinese Railways (84283 A). Map and Ills. 2500 w. Engng—Jan. 25, 1918. Serial, 1st part. Effect of the war on railway construction and the development of China.

Santa Fé

Efficiency on the Atchison, Topeka and Santa Fé (84078 A). Ills. 3000 w. Ry & Loc Eng—Feb., 1918. Advantages of using oil fuel; details of construction and repair of oil-burning appliances.

TRAFFIC

Car Shortage

Car Shortage, Its Present Condition and Its Remedy (84229). Charles M. Upham, before Richmond meeting of Am. Assn. of State Highway Officials. 3000 w. Br Rds & Sts—Feb., 1918. Steps that have been taken to improve car shortage and the importance of improving highways.

The Car Conservation Problem Solved in China (84157). John Earl Baker. Ills. 1500 w. Ry Age—Feb. 8, 1918. How results are secured.

Freight Houses

New Freight House for the Illinois Central R. R. at Champaign, Ill. (84316). Ills. 1100 w. Ry Rev—Feb. 16, 1918. Detailed description of building for the Illinois Central R. R.

New Freight Terminal of P. C. C. & St. L. Ry., at Indianapolis (84317). Ills. 1000 w. Ry Rev—Feb. 16, 1918. Track elevation and freight house construction data.

STREET AND ELECTRIC RAILWAYS

Boston Elevated

Public Control; Guaranteed Dividend; Higher Fare for Rehabilitation (84203). 5500 w. Elec Ry Jl—Feb. 9, 1918. Plan recommended by Mass. Pub. Serv. Commission for restoring Boston Elevated Ry.

Car Equipment

Considerations in the Choice of Car Equipment (84454). C. W. Squier. Diagram. 1800 w. Elec Ry Jl—Feb. 23, 1918. How a traffic survey to determine requirements is made.

Car Lighting

An Improved System of Lighting Interurban Trolley Cars (84174 A). W. J. Walker. Ills. 2500 w. Gen Elec Rev—Feb., 1918. Details of a motor generator set designed to maintain constant voltage.

Car Operation

Some Legal Aspects of One-Man Car Operation (84263 A). Alexander Shapiro. 10500 w. A E R A—Jan., 1918. Attitude of commissions toward their use is more favorable.

Cars

Classifying Passenger Cars for Given Conditions (84458). Norman Litchfield. Ills. 2500 w. Elec Ry Jl—Feb. 23, 1918. Six categories of service outlined.

Electrolysis

Electrolysis—Troubles Caused Thereby and Remedies Which May Be Applied (84[illegible] B). Albert F. Ganz. Ills. 33 pp. Stev Indic—Oct., 1917. Damage from stray electric currents and the remedies.

Elevated Rys.

Rebuilding [illegible] Under Regular Schedule [illegible]. 2500 w. Elec Ry Jl—[illegible]. More than $10,000,000 has been [illegible] hattan elevated [illegible] miles of expre[illegible] capacity and other [illegible]

Fuel Saving

Saving Fuel Through Operating Economies (84202). 3000 w. Elec Ry Jl—Feb. 9, 1918. Shows how more than 25,000 tons of coal can be saved yearly on Washington (D. C.) electric railways. Closer control of car operation.

Maintenance

What the Maintenance of Way Department Does (84455). R. C. Cram. 3500 w. Elec Ry Jl—Feb. 23, 1918. Improvements suggested.

Montreal

Six-Motor Multiple Unit. Trains for Montreal (84689). Keith MacLeod. Ills. 1500 w. Elec Ry Jl—March 2, 1918. Features of operation.

Power Plants

Electric Railway Power Plant and Its Personnel (84456). Hartley LeH. Smith. 2500 w. Elec Ry Jl—Feb. 23, 1918. Need of technical men in the boiler room.

Power Saving

Connecticut Company's Power Saving Campaign (84700). William Arthur. Ills. 3000 w. Elec Ry Jl—March 2, 1918. Systematic educational work has reduced energy consumption per car mile by 11 per cent in five months.

Traffic Relief

Practical Traffic Relief Offered to Washington, D. C. (84314). 1100 w. Elec Ry Jl—Feb. 16, 1918. Second section of Beeler report recommends eight stops per mile in city and six in the suburbs.

BOOK NOTICES

ENGINEERING INDEX

THE ENGINEERING INDEX ANNUAL—1917, 364 pp. Size, 7x10 inches. Price, $3 New York: The Engineering Magazine Co. This is a compilation of all the monthly issues of the Engineering Index published in Industrial Management during the year 1917. The main divisions follow the same order as in former issues of the Index Annual, but are subdivided alphabetically; so that any item may readily be found by examining the classification index at the beginning of the volume.

INDUSTRIAL MANAGEMENT

EFFICIENCY METHODS, by M. McKillop and A. D. McKillip; 216 pp. Size, 5x7½ inches. Price, $1.50. New York: The D. Van Nostrand Company. A brief review of management methods for all departments of a manufacturing establishment. The authors recommend, as a preparation for the methodical study of their work, the perusal of some of the writings of Gantt, Emerson and Gilbreth. The book is well subdivided for consistent study and has an excellent index.

FUNDAMENTALS OF COST AND PROFIT CALCULATION, by Robert S. Denham; 118 pp.; size, 5x8 inches. Price, $1.25. Cleveland, Ohio: Cost Engineer Publishing Co. A book written for the man who wants to know more about cost and profit and the items that properly constitute each of these fundamentals of business. It will clear up, for many a reader, the hazy ideas that many confessedly possess. One of the best features of the book is the chapter devoted to the terminology of cost engineering, which defines in a clear and simple manner the terms in common use by cost engineers. In addition, there is an index of this terminology as well as an index to the entire volume.

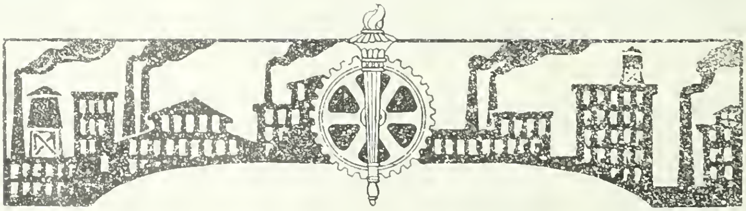
MECHANICAL ENGINEERING

INTERNATIONAL RAILWAY FUEL ASSOCIATION. Size, 6x9 inches; 416 pp. Proceedings of the Ninth Annual Convention held at Chicago in May, 1917. The papers presented at this convention are of interest to all power plant engineers, although giving results of experience with combustion of fuel in locomotive boilers. One of the most important topics is that of pulverized coal burning; its methods and results. Copies may be obtained from the Secretary of the Association, J. G. Crawford, Chicago, Ill.

POWDERED COAL AS A FUEL, by C. F. Herington; 212 pp.; size, 6x9 inches. Price, $3 00. New York: The D. Van Nostrand Company. An excellent manual describing the preparation, methods of feeding and results obtained in the use of powdered coal in various industries. It is copiously illustrated and has an index as well as a complete bibliography of the subject.

MACHINE SHOP PRACTICE, by William B. Hartman; 248 pp.; size, 4½x7 inches. Price, $1.10. New York: D. Appleton & Co. A useful, clearly written book describing the principal operations of a machine shop. It will prove valuable to students and apprentices as well as to experienced machinists. Correct methods in use of tools and machine operation are given and greatly enhanced by a large number of illustrations. The appendix contains a few of the more commonly used tables.

FINDING AND STOPPING WASTE IN MODERN BOILER ROOMS: 274 pp.: size, 5x7 inches; flexible covers. Price, $1 00. Philadelphia, Pa.: The Harrison Safety Boiler Works. This is a reference manual for managers and power plant engineers, giving a large amount of information on fuels, combustion and allied topics. Results of recent tests are presented and considerable attention is paid to design and arrangement of boilers.



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How We Trained 5000 Women

After Three to Ten Days they do Precision Work on Fuses and Instruments

By C. U. Carpenter

Hundreds of thousands of American women must enter industry and work there with their whole heart and mind and strength before the war is won. Upon industrial managers rests the responsibility of making the greatest possible use of their energy and efforts. In this article Mr. Carpenter *gives the principles and methods followed in his own plant for training women in skilled occupations. His plans have been adopted as standard by the United States Government.*

Mr. Charles U. Carpenter *has had extensive experience in electrical manufacturing and supervision of manufacturing plants. He was factory supervisor and afterward head of the labor department of the National Cash Register Company. Later he took a similar position with the Herring-Hall-Marvin Safe Company, finally becoming President of that concern; still later he was President and Manager of the Fire-Proof Furniture and Construction Company, and is now Vice-President and Works Manager of the Recording and Computing Machines Company.*

THE Army and Navy requirements are already making severe drafts upon the body of skilled workmen throughout the United States, and the munitions trades are feeling this drain severely. The present state is only the forerunner of a much more severe condition for, try as we may to avoid this problem by special exemption, we cannot avoid the loss of these men. Their services on the firing line, and as mechanics back of the fighting front are absolutely necessary, and their necessary presence there severely weakens the production of the much needed munitions in the factories of America.

It is, therefore, evident that the supply of operatives must be made up from the ranks of older men, clerks, and other office employees, most of whom are unskilled in mechanical trades, and women who know nothing of such work. This is the condition that we will soon face; we should not wait, but prepare to meet it *at once.*

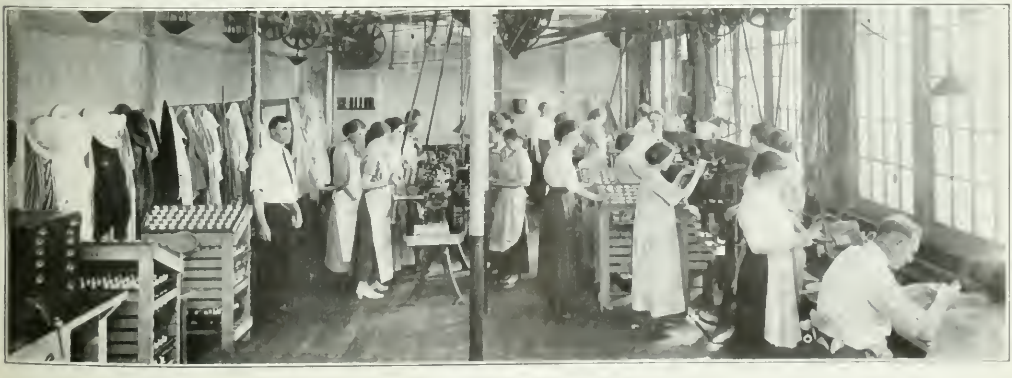


FIG. 1. A VIEW IN THE SHOP TRAINING SCHOOL FOR WOMEN EMPLOYES OF THE RECORDING AND COMPUTING MACHINES COMPANY

This mass of unskilled employees cannot be put in the places of the skilled workmen without endless derangement of industry, unless some special methods are adopted to prepare them for their work *before* they begin.

We have before us many illustrations of the weaknesses of adhering to the method of taking any men that come along and putting them on a job, letting them struggle along, trying to learn the "how of the job" alone and unaided. The example of the ship-building industry is enough to prove the inefficiency of such methods, and they should not be followed.

The Principle of "A Best Way"

We must remember that unless some special methods for teaching have been introduced into the shop, the foremen do not have the time to bother with the poor worker, and consequently usually discharge such help as fast as the employment bureau can hire them, with the result of a large labor turnover and small output. We must also remember that when employees are placed in the factory without any preliminary instructions, they must necessarily learn how to do their work from workers about them. Thus they learn all of the faults of these other employees, and what they do learn they learn slowly. They likewise consume the time of those who are trying to show them how to do the work, and the losses from scrap are very great.

There can be no question but that there is always *a best way* of performing every operation and numberless *wrong* ways of doing it, and every practical production man knows that the average worker will usually perform the operation by an inefficient method if left to learn alone. Now we must consider the fact that every manufacturing business depends for its success upon accurate, efficient shop production—that this production, no matter how complex or how difficult, in the last analysis is made up of a multitude of small individual operations—that the efficiency of the *entire* production depends wholly upon the efficiency with which the *small individual operations are performed.* Therefore, we should determine the most efficient method on all operations. This is now *common production practice.*

Now while it is quite true that a real study of each operation down to its finest point is very desirable, and that the best results can be secured by such close study, yet the average manufacturer, superintendent or foreman is often affected by the thought of the seemingly endless work involved. The writer has found it quite a simple undertaking to classify all similar operations together, and a careful study of each classification will lead to quick results and conclusions sufficiently accurate for the purpose.

The production man can soon learn that in the average shop the actual output can, by simple, common, horse sense methods, be increased from 30 to 50 per cent. and surely such results are enough worth while to justify such careful study and developments of method.

If we grant that there is "a best way" (and we must, of course) and that output can be increased if the operators use this "best way" we are forced to admit that the next sensible step is to train them, so that they *can* and *will* do so.

Experience in Our Factory

As the best example is an actual one, I will cite the experience of the organization of The Recording & Computing Machines Company, Dayton, Ohio, which illustrates the point. This factory employs 8,600 people of whom over 5,000 are women. Practically all of the mechanical operations, assembling and inspection was performed by women.

The work this shop was doing was of a close, accurate character in aluminum, brass and various other materials, the article being the Russian combination time fuse. The manufacturing limits ran as low as 0.0005 inch in a metal particularly difficult to work.

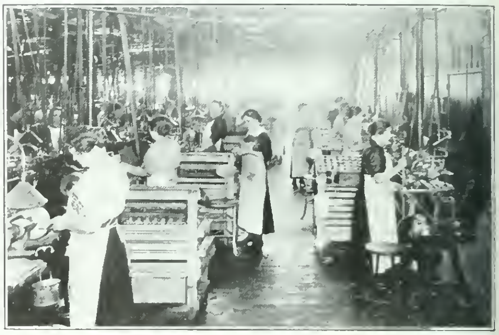


FIG. 2. WOMEN IN THE HAND SCREW MACHINE DEPARTMENT

The machinery includes every variety such as: hydraulic presses, punch presses, milling machines of all types, hand turret screw machines, automatic screw machines, thread millers, drill presses and special machinery designed and built by the company. The company faced a totally inadequate supply of skilled labor usually considered necessary for such work. Men of any kind were scarce and many of these belonged to trades not at all allied to the mechanical trade—bricklayers, structural steel workers, masons, all intelligent men accustomed to high wages, naturally unwilling to accept a laborer's work at laborer's pay, and yet unable to bridge the gap caused by their ignorance of mechanical methods. But this gap, if bridged, could lead to good jobs at excellent pay and would give the employed the benefit of their intelligence and manual skill.

The other available supply was the women, intelligent, healthy, quick and earnest, yet barred by lack of knowledge. We felt that there must be thousands among all the walks of life who would gladly do this work if only they could be imbued with enough confidence to try it and be trained to do it.

The Woman Beginner's Fear and Dread

The writer, before the training department was started, noticed particularly that when new girls came into the shop they were very nervous—badly frightened—and that they would often break down and weep because of the actual fear that took hold of them when they first stood before a big machine tool, the like of which they had never seen before, the uses of which they could not conceive, and which looked like a veritable monster to them. The more earnest a girl was, the greater her terror and the net result was that the foreman in his impatience, promptly and continuously fired the best class of employees that it was possible to get.

I found that those who did remain were slow to learn, took much of the time of other operatives, and learned bad methods. Also their percentage of scrap was very heavy.

After considering the advantage of putting these new girls in a quiet, well organized training department where they could be taught carefully and in a kindly manner, and then turning them into the production department as semi-skilled operators, I started the school. (See Figure 1, on page 353 of this article.)

The Training Department

The Training Department was located in a room entirely separate from the factory, particular care being taken to see that it was well lighted. We placed therein all the different types of machines upon which we considered training necessary and, in addition thereto, placed the necessary benches and fixtures for the teaching of inspection and assembly. We naturally found that one of the most important points was the selection of a proper head for this school. We secured a man who was a gentleman and who could get along with the women, and made sure that he was an expert mechanic and operator. In this connection, I have always found that the tendency has been to select men who were not sufficiently experienced.

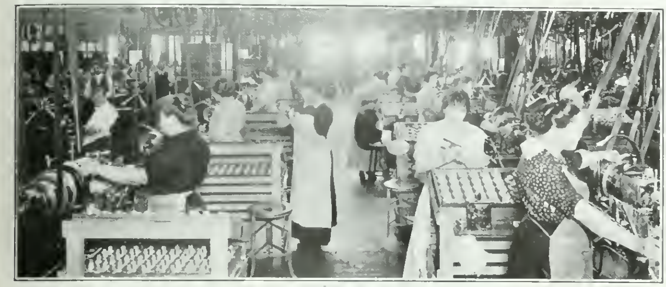


FIG. 3. ANOTHER VIEW OF THE HAND SCREW MACHINE DEPARTMENT

In all cases where the women were taught the different jobs, the *teachers were women*. Women teachers were selected, so that when the new girl employee came into the training department ready to begin this strange work, the very first thing that she saw were these women teachers operating machines. Invariably this new employee would make up her mind at once that if *these* women could do the work, so could *she*. Naturally these women teachers were selected with great care, keeping in mind not only their skill as operatives, but also their capacity as teachers.

Careful Selection Necessary

The Employment Department (which we consider as of primary importance) selected the employees with care, keeping in mind the work that they were supposed to do, it being evident that some women were well fitted to handle certain heavy-duty machines, while others could handle only the light machines. It should be noted here, that the foremen are not permitted to employ people, nor are they even permitted to recommend employment. Every effort is made to keep relatives or friends out of any man's department, so that there can be no favoritism charged on the part of any employee after he once gets into the shop. The employment of both men and women is attended to by the Employment Department without any suggestions being permitted from anyone.

We standardized carefully the system of teaching. A teacher handles from three to five girls at one time, depending upon the nature of the work. She first explains the character of the metal in the part, and the kind and function of the tools that were being used, going over very carefully with each individual employee the work that each tool was supposed to do—she operating the machine in order to illustrate each point. The new girl employees are then permitted to start the work themselves and each time any error is made, they are corrected in a kindly manner and encouraged in every way to do their best.

Only Specialized Skill Is Expected

It is particularly important to note again that these new operators are trained to become skilled *only upon one particular job*. We do not attempt to give them a general mechanical education, for, in the first place, this would take too long, and again, we find it unnecessary as the employee becomes skilled on the one particular operation that she is being taught in a very short period, and any general mechanical knowledge necessary comes to her through her work in the shop.

The work in the Training Department sometimes develops the fact that the selections for the different operations as made by the Employment Department is not always best, and when we discover this, we shift the employee from one operation to another until the one for which she is particularly suited is found—we do this in the Training Department so that we will not have to do it in the shop.

The operators are taught, not only the use of the different tools, but also the use of all the necessary gages. They are paid 20 cents per hour while they are being taught, and a careful record of their progress and efficiency is kept. The length of time required for teaching operators varies both with the operator and the class of work, but on the average, it ranges from three to not over ten days.

In less than ten days' time we turn out from this Training Department girls who can operate hand turret lathes on work requiring great precision. (See Figure 2.) Each machine tool in the Training Department naturally gives us a greater production than would have been the case had we adopted the old plan of training the girls in the shop with the same machinery. After this preliminary training these girls, when entering the shop, attack their machines with vigor and confidence, and it does not require more than three weeks for them to reach a high average of production, and thus begin to earn bonuses, distributed under the graduated system of pay which will be described later. It is, of course, *necessary to continue in the shop the training* received in the school, and the organization was built up in such a way as to insure this.

Duties of the Job Boss

We divided the operatives into comparatively small groups, placing over each group a carefully selected male job boss. We use great care in determining the number of operatives under each job boss, being careful not to put under his control more than he could efficiently supervise, the number ranging from seven on more difficult jobs to 30 on the less important ones. It is this job boss's duty to set up the machines, keep them in excellent running condition and see that the defective work is kept at a minimum. He is responsible for both the quality and quantity of work delivered from his particular group.

To insure that the women operatives are treated fairly, and carefully supervised by the job boss in order that their production may be brought up to as high a degree as possible, we first established the rule that the job boss could not discharge his operatives, and then, developed a bonus plan of pay for him whereby the amount of *his* pay depended upon the *average* bonus of *all* of his operatives. It thus becomes to his interest to help the newer and poorer operatives, rather, than concentrate his attention upon the good ones. It is always not only interesting, but indeed amusing to see the earnest way in which the job boss will pay attention to and assist the new and comparatively poor worker under this plan, because *his* pay depends upon *her* efficiency.

We are careful to get men who will treat the girls properly and who are well trained in this work. We are careful to see that the job bosses do not drive their girls to a rate of production so high as to endanger their health or make them nervous. The company impresses its policy of treating its employees fairly upon the job bosses, foremen and superintendents at frequent meetings, at which time the aim of the concern is explained and insisted upon.

An Example of Results

As an example of what can be done by inexperienced women on difficult operations I give you the following: We produce our base forgings of aluminum on hand turret screw machines. On this particular forging there are 56 gaging points, with allowable limits on different operations ranging from 0.0005 inch to 0.002 inch. In January, 1916, the average production of 31 women employees was eight pieces per hour. While the operatives were apparently busy at this rate of production, my experiments showed that there should be produced from those machines as a fair production an average of 35 pieces per hour. We put our old operatives into the training department, and within four weeks after the new and old operatives had been through this training department, the average production was raised to over 25 pieces per hour, and today the average is over 55 pieces per hour. The same results were obtained on all of our work, such as machining, inspection and assemblage. (See Figure 3.)

It is particularly important and interesting to note that many of our most skilled operatives are men and women well along in life. We find that while the young worker has more vigor, the older one is usually more careful and steady, and more anxious to keep up a high average rate of production. Their continuous work on their jobs bring this average production up to that of the younger and more vigorous.

We have demonstrated that strong, healthy women can do work requiring great precision after they are thoroughly trained quite as well as skilled men mechanics. As stated before, they work on hand turret screw machines, hand millers, power millers, drill presses, thread millers, punch presses, routers and special machines of all types. They are remarkably efficient as inspectors. We have also taught them to be excellent tool makers. (See Figures 4 and 5.)

Women As Assemblers

As an example of what women can do in assembling, I give the following data: We have a large assembly department, employing over 2,000 girls. Two sets of prominent engineers who investigated the possibilities of production from this plant reported that the best ouput possible from this assembly division was 15,000 complete fuses per day in two shifts. By thoroughly training the girls we have been able to reach an average production of THIRTY-EIGHT THOUSAND PER DAY IN ONE SHIFT. (Figure 6 shows this department.)

In addition to the fuse work, our company is building optical instruments of a character that requires the greatest precision, much of the work being held within limits of 0.00025 inch. This work requires not only close manufacturing, but also most careful work in lens making and grinding.

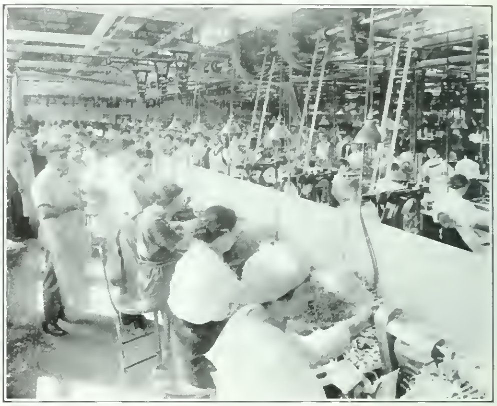


FIG. 4. WOMEN OPERATORS IN THE HAND MILLING DEPARTMENT

Before beginning this work, the organization made a minute survey of each operation, no matter how small, involved in the production of these instruments. This included all the manufacturing, assembly and lens grinding work. This company was compelled to build its own lens grinding machinery, as none could be purchased in this country. When we finished this survey, we had before us a description of exactly what was required on each operation. There was necessarily much work that was entirely new to us, as well as to other American manufacturers, owing to the lack of experience in this work in the United States.

It is interesting to note that we were advised that it would be impossible for us to get any high grade lens grinders in the United States, and many dire prophecies were made as to our probable failure. However, we started the training school in the grinding of lenses, and have developed a high grade body of lens grinders, both men and women within the past six weeks.

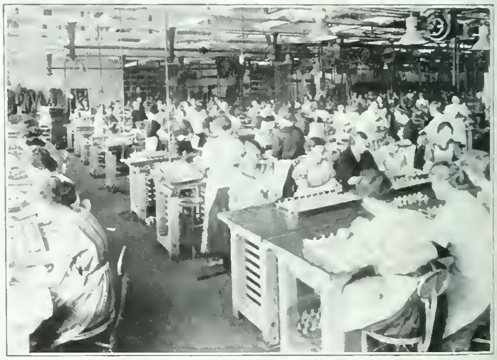


FIG. 5. A VIEW IN THE INSPECTION DEPARTMENT

Our General Principles

While this article deals only with the question of the training of operatives, it should be understood that this is only a portion of our plans for securing maximum efficiency, satisfying our employees and securing greater production. Our complete methods are comprehended in the few general principles, which are as follows:

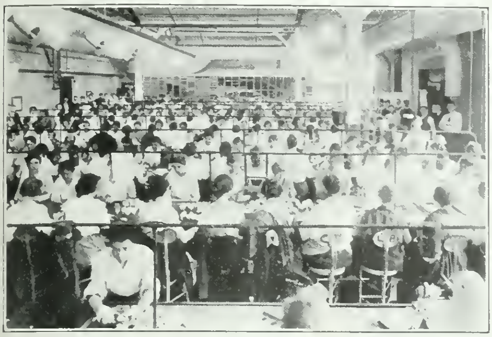


FIG. 6. ASSEMBLY DEPARTMENT GROUP

1. Treating our employees fairly and equitably.
2. Giving them a chance for advancement, based upon merit.
3. Establishing a fair wage system.
4. Training them to become more efficient, and thus more helpful, both to themselves and the company.
5. Showing an interest in the individual worker, instead of considering them as a mass.

I have always considered that a fair and just method of selecting operatives for advances is one of the essential points in factory management. In this case the giving of employees a fair chance of advancement is controlled by keeping records showing the efficiency of the individuals and providing that when an opportunity of advancement arises, selection shall be based upon past performance alone. We always select the operator with the best record. Each operator in the shop knows that his promotion is controlled and determined by fair and unbiased standards and that his interests are well protected.

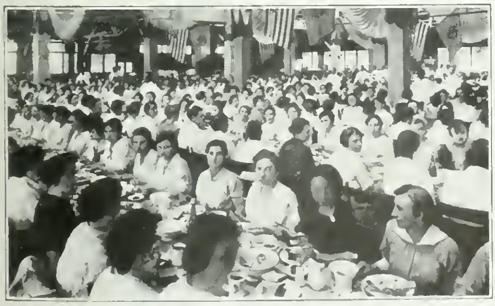


FIG. 7. RESTAURANT OF THE RECORDING AND COMPUTING MACHINE COMPANY

The system of training should be thorough, and should be designed to have it continued when the operatives go into the shop, through the job bosses, and in some cases through special shop instructors. The system of organization and training should be such as to compel the subordinates and directing heads of departments to give the closest attention to the new and comparatively inefficient employees, and train them to become better workers.

Our Company's Bonus System

There should be a fair and liberal system of pay which will reward the employee for reaching high rates of production. This should be based upon the ruling that the women should get the same pay as the men for the same amount of production. The system of pay should provide bonuses worked up in such a manner that the average operator can earn bonuses even when they produce less than the possible number of pieces per hour. Our graduated bonus system of pay is an original one with the writer, and has provided an excellent stimulus to the operatives without inducing them to overwork themselves.

Its main principle is a graduated bonus system of rewards. By this method the operative does not have to reach the highest rate of production before earning a bonus, but bonuses are graduated so that the operative will earn a fair bonus at the lower production points, of course, earning more as they increase production. Care is exercised to see that these production rates are fair to the operative. By the graduated system the usual criticism of the bonus system is done away with as the operative does NOT have to reach the highest possible point of production as determined by time studies, before beginning to earn bonuses. *Once* the bonus rate is set, it is *never reduced*. If employees complain that the bonus is too low, a careful investigation is immediately made, and, if their contention proves correct, the rate is raised at once. If, however, the rate proves to be a proper one, we take pains to prove to them that *it* is what it should be.

There should be a degree of supervision that will prevent the operators from overworking or straining themselves, through attempting to work too hard, in order to earn higher bonuses.

As stated above, we have a simple system of checking up outputs of operatives and groups, so that we can detect inefficiency. When this inefficiency of any operative or group is observed, we do not attempt to drive them to meet the proper output, but go to them in a kindly manner and endeavor to find out the difficulties. If they are falling behind due to lack of training we send them back to the Training Department. If it is due to inability to keep up with the work owing to lack of strength, we transfer them to some other job better suited to their strength and capacity, for we feel that any operatives, after being employed by us even for a few weeks, should not be let go if they show a proper degree of interest. Thus we keep our turnover of labor down to a minimum.

In addition to these methods, we have, of course, the hospital, with its nurses and doctors, restaurants, a company band, and rest periods of ten minutes each in the morning and afternoon, all of which are most excellent. (The restaurant is shown in Figure 7.)

Our organization of managers, superintendents, and foremen all strongly believe that the simple direct method of training operatives to do the particular job for which they are selected will result in producing quickly, working people, either men or women, who will prove remarkably efficient on the particular job for which they are selected. We know that if the training is linked up with a system of management that looks out for the workers' welfare, that provides a just and fair method of promotion so that the worker can, through honest effort, break away from his old job to advancement, that provides a fair wage system, there will result a working body filled with enthusiasm and willing to respond to any call for extra effort.

British Shell-Shop Handling Devices--II

Jib and Portable Cranes, Travelling Jib Cranes, Telphers, Transporters and Shell-Holding Appliances

By George Frederick Zimmer

The second installment of Mr. Zimmer's series, dealing with devices that have made the employment of women possible in British munition shops, takes up handling devices for conveying objects while suspended from above. Numerous illustrations show this machinery in use, and of special value to the American manufacturer are the details of gripping and holding devices for shells from the 3-inch to the 15-inch size.

Mr. George Frederick Zimmer *was associated for fifteen years following 1882 with Mr. James Harrison Carter, the well known pioneer engineer of English roller milling. In 1897 he started practice as a consulting engineer, and at the same time began to market a reciprocating conveyor of his own development. He is a contributor to the technical press and an extensive writer on the art of mechanical handling of materials and is the author of two books, "The Mechanical Handling of Material," published in 1905, and "The Mechanical Handling and Storing of Material During and After the War," published in 1917.*

IN many British munition factories each machine tool is provided with light lifting tackle or runways suspended from overhead girders, to enable the women workers who predominate in these national establishments to lift the shells without fatigue from either a truck or the ground to their position on the machine, a method which has been in use for years in engineering shops and which is too well known to need any further comment. The overhead travelling crane and its use is also sufficiently well known. Instead of, or in addition to, such simple overhead tackle smaller cranes have been introduced to reduce the work required from overhead cranes, and also to render the lathes more independent and therefore more effective; these are employed in connection with the bigger machine tools, either one crane attached to each tool or a larger one located between two such tools serving both.

If belonging to the former order they are sometimes in the form of a simple ship's davit attached to the front or side frame of the lathe. A lifting drum with ratchet and pawl detent is fitted to this so that a girl can lift, for instance, a rough 9.2-inch forging into a machine. These davits have been instrumental in materially increasing the output of the tools to which they are attached.

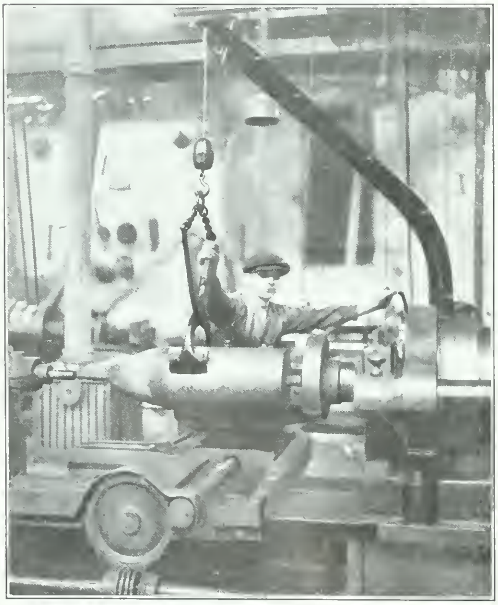


FIG. 24. PICKERING JIB CRANES HANDLING A 9.2" SHELL

A similar device of the second class, often employed, is a crane of a more ordinary type with a balanced jib and fitted with the same kind of lifting gear as that of the davit. This shell crane is usually erected between two lathes and can swing over the front one to feed the other behind. The jib is of a fixed length so that a shell is lifted and swung exactly into the lathe centre or "chuck" as required. Therefore, no running head or so-called travelling monkey need be fitted. The relative position of the crane to the two lathes it serves is so chosen that both can deliver or receive a shell from one to the other with the greatest precision. These cranes are handled by the girls without any extraordinary exertion and without fatigue. The crane post is usually set a little out of perpendicular so that when not in use the jib will automatically swing inward (like a park gate) and will therefore not project into the bay and impede traffic or cause other inconvenience.

Small Job Cranes

A variety of such cranes, both stationary and portable for various handling operations in and about munition factories, is built by Messrs. Pickerings, Ltd., of Stockton-on-Tees. They are designed for loads of 200, 600, and 800 pounds with a radius of 4 feet for the stationary, and 6 feet for the portable types. The columns are of circular cross-section. The jib is built up of steel plates stayed and riveted, and for the larger size counterweighted.

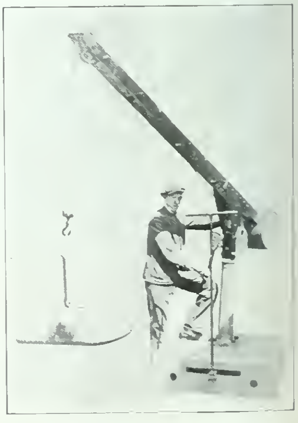


FIG. 25. PORTABLE CRANE FOR 9.2" SHELL

Figure 24 shows one of these cranes used by a boy for handling a 9.2-inch shell on and off a lathe. These cranes are mounted on cast-iron foundation blocks fitted with ball thrust bearings so that the jib can be slewed by hand with a minimum of effort. The hand-winches have steel, machine-cut worm gears, while the worm-wheels are of gun-metal and, unlike other winches, they are self-sustaining, that is to say, when the handle is released the load will remain stationary in any position without the use of ratchet wheel or pawl. The axis of the operating handle by means of which the load is raised, is 3 feet 9 inches above the floor level and the throw of the crank is 10 inches. These dimensions have been found suitable where girls are employed and considering the latters' strength and reach.

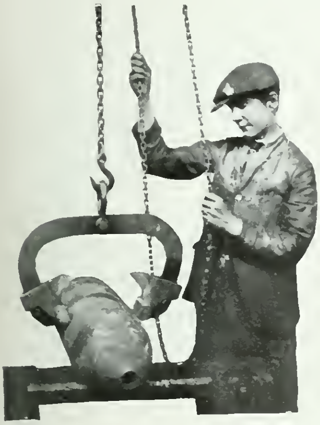


FIG. 26. POSITION BEFORE GRIPPING

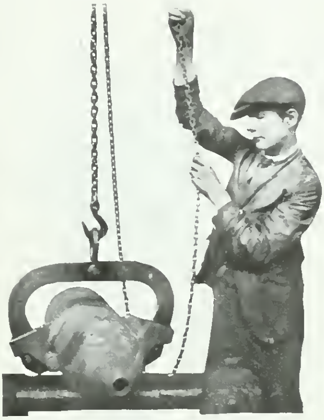


FIG. 27. POSITION WHILST GRIPPING

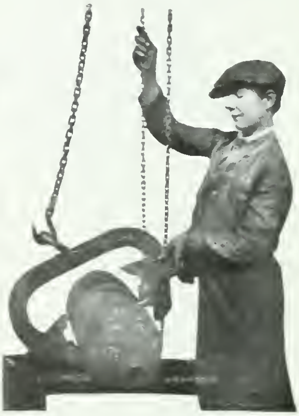


FIG. 28. POSITION ON RELEASE

PORTABLE CRANES

The portable cranes are of similar construction but have counterbalanced jibs and are mounted on four wheeled bogies and rails, or arranged to run on a concrete floor. The wheels are contained within the enclosed base, see Figure 25. The gauge of the two smaller sizes for 200 and 600 pounds is 2 feet 9 inches and that for the 800-pound crane 3 feet 6 inches.

The same firm also build a three-motor, electric-locomotive, hammer-head crane for maximum loads of 600 pounds which is especially intended for handling 9.2-inch shells. This has a radius of 10 feet and a height of 13 feet 8 inches from the jib pulley to the floor. The jib revolves on a ball race through a complete circle and the motor will completely revolve it in 30 seconds. The hoisting speed is 20 feet per minute and that of travelling 300 feet.

GRIPPING AND HOLDING DEVICES

In connection with these cranes and, indeed, for attachment to cranes of all makes as well as telphers, quite a number of ingenious gripping and holding devices have been introduced by the same engineers for handling all sizes of shells, some of which are shown in the views Figures 26 to 37, both inclusive. One of the best and most recent is that known as the Fothergill shell-lifting dog. This is built up of a flat steel bar bent into the shape of the letter C with a sliding jaw slipped over each end and held thereon by a pin passing through the two ends of the bent bar. This dog is illustrated in three position, of which Figure 26 shows how the jaws are lowered and automatically expand until the distance between them is equal to the diameter of the shell when the jaws drop and automatically grip the shell. Figure 27 shows how on hoisting the shell is lifted, and in Figure 28 the release of the shell is illustrated; this is effected by lowering and sliding one jaw up the inclined plane which releases it. These devices are made for 6, 8, 9.2, 10, 12 and 15-inch shells. They are equally applicable for handling rough billets, rough turned shells, and are copper faced when used for handling finished shells. The self weight of these dogs is, respectively 26, 36, 44, 54, 86, and 166 pounds.

A special form of shell carrier is shown in Figure 29, and consists of a swivelling apparatus in which the shell is held in a bridle by a hand screw. When required to raise a shell the bale can easily be slipped over it while lying on the ground, after which the hand-screw is tightened and the catch made to engage with the bridle. This catch is pivoted from the one shank of the lifting bale and is for the purpose of holding the shell in a horizontal position.

A different principle is employed in the tongs illustrated in Figures 30, 31, 32 and 33, the first of which, Figure 30, is capable of gripping rough billets weighing one ton. The illustration is self-explanatory and it will only be necessary to point out that the opening of the jaw is limited by a horizontal bar pivoted to one of the shanks of the handles of the tongs and slotted at the other to engage a stud. This arrangement prevents the jaw from closing entirely when suspended idle from the chain, which would prevent its use without assistance by hand. At the same time the jaws are held open when the chain is slack so that the shell can be easily disengaged. As a matter of fact this provision only permits the tongs to open sufficiently wide to fit loosely over a shell or billet of a given size and close sufficiently upon the same size to grip securely; it will be seen from the illustration that it is necessary to allow only a very little latitude owing to the shortness of the slot. Tongs for smaller shells are not thus provided, see Figures 31 and 32.

For holding shells in a vertical position tongs as shown in Figure 33 are employed, and a similar one for dealing with ammunition cases is shown in Figure 34. In this case the jaws are made of T-iron and swivelled at the end of the tong levers, so that they grip the vertical battens of the case at four symmetrically disposed positions. Messrs. Pickerings also make tongs which enable shells to be lifted in an upright position by gripping them from the inside. Figure 35 shows a 6-inch shell so held at its bottom end, while Figure 36 shows one held by a device which expands by spring catches inside the bore of the shell. This is released by the small hook. A different principle again comes into play with the gripping device shown in Figure 37 which holds the shell vertically by friction grip. This device is made in two different ways, one as shown, and another type in which half the strap encircling the shell is omitted in order that it may be slipped on with greater ease and sidewise instead of only from above For handling finished shells the grippers are lead or copper lined.

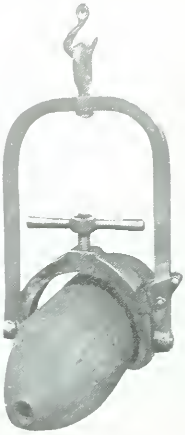


FIG. 29. BALE SHELL CARRIER

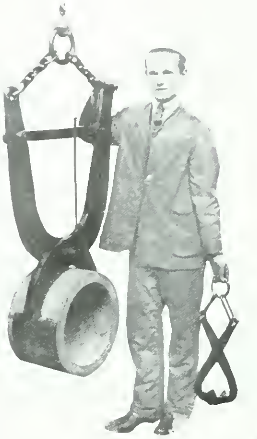


FIG. 30. SHELL LIFTING TONGS FOR ROUGH BILLETS

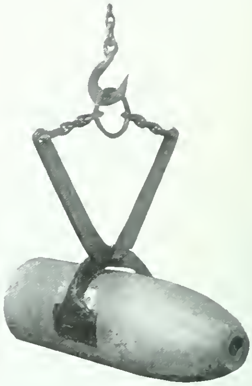


FIG. 31. SHELL LIFTING TONGS

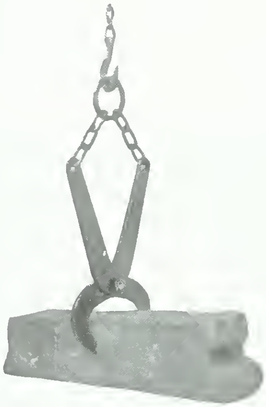


FIG. 32. SHOWING TONGS LIFTING BILLETS

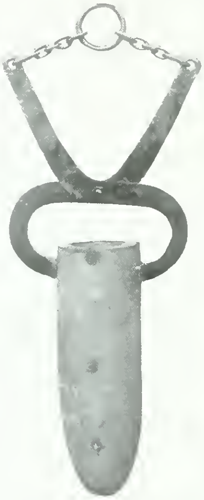


FIG. 33. TONGS LIFTING SHELL ENDWISE

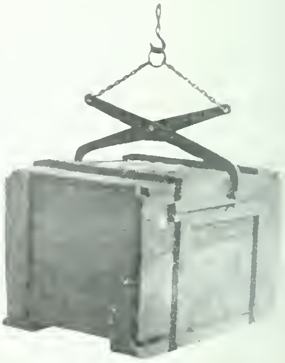


FIG. 34. TONGS LIFTING MUNITION CASE

Other devices for the same purpose but holding more than one shell will be described in connection with other lifting appliances.

Steel tubs are used in some of the national shell factories in connection with all kinds of cranes where a large number of shells have to be handled in one operation. Figure 38 shows such a tub in two views; it handles 16 shells 6 inches in diameter. Figure 39 is a similar tub employed for handling two tons of base plugs for 9.2-inch shells; these tubs are constructed of ¾-inch mild steel plates.

PORTABLE HAMMER-HEAD CRANE

A useful portable type of hammer-head crane extensively used in munition factories is manufactured by Royce Ltd. of Manchester. Both a stationary and a portable example are shown in Figures 40 and 41. Those of the portable type run on rail-tracks of four-foot guage laid level with the shop floor, and are designed for maximum loads of half a ton, with a maximum radius of action of 10 feet; or, alternatively, for 600-pound loads with a radius of 16 feet. These cranes are fitted with two motors, one for hoisting of 1 b.h.p., and one for travelling of 3 b.h.p.; the hoisting speed of the 1000-pound crane is 20 feet per minute with a maximum load, while that of the 600-pound crane is 30 feet. The speed is doubled in both cases when running light. The speed of travel is in each case from 200 to 220 feet per minute; the slewing is easily effected by hand. The driver has his seat on the carriage where he has the controls of the motors in front of him and can easily operate the crane in all its functions. The current is conducted to the crane either by means of a conduit between the track, or by overhead live wires on the trolley system.

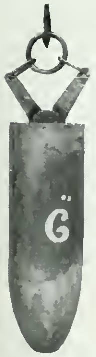


FIG. 35

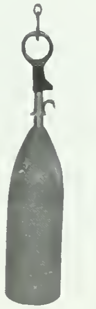


FIG. 36

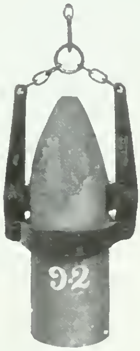


FIG. 37

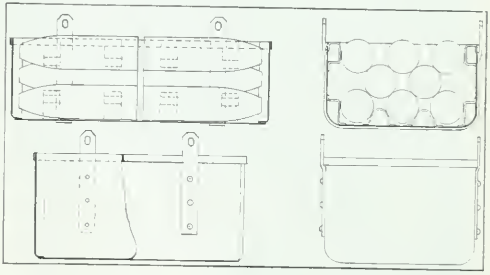
FIG. 35. INTERNAL GRIPPING TONGS HOLDING 6" SHELL
FIG. 36. SHELL CARRIER WITH SPRING CATCH
FIG. 37. GRIPPING DEVICE HOLDING A 9.2" SHELL

Overhead Travelling Jib Cranes

An overhead travelling jib-crane, used instead of those running on rails on the floor like the hammer-head crane just described, is mounted between two monorail tracks, the lower one of which is raised on trestles about 7 feet above the factory floor level. The building in which it is used consists of two bays each about 50 feet wide and 400 feet long. In each bay there are two rows of machine tools, and one of the travelling cranes, erected in a central position, serves these two lines of machines, and conveys all the billets and shells to them. Each crane has a jib of 10 feet 6 inches radius, which is sufficient to extend to the centre of each line of lathes served. Figure 42 shows a line drawing of this arrangement while Figures 43 to 47 show views of an installation somewhere in Scotland.

The cranes are supported by a single line of bulbhead rails, riveted to the I-beam which forms the top part of a supporting gantry. The base of the crane post is mounted on a trolley which travels on this rail, while the upper end is maintained in a perpendicular position and prevented from tipping over by another rail and two pairs of rollers which abut against the vertical edges of this H-rail, which is attached to the roof trusses of the building. The cranes pass clear between the driving shafting, pulleys and belts of the lathes; they are designed to lift a maximum load of 1500 pounds.

These cranes are electrically driven and fed from a live wire running parallel with the upper rail, separate and independent motors being provided for the three operations of lifting, slewing and travelling. The controls are operated from the small attendant's platform on the right, see Figure 42. The motors are of the slip-ring type, for 3-phase current. The hoisting and travelling motions are transmitted by ordinary spur gearing fitted with the usual magnetic brakes. For the slewing motion worm reduction gearing is used, the worm running in an oil-tight gear case, a slipping clutch being fitted to take up any shock due to sudden starting or stopping. The obvious advantages of these elevated cranes is that they do not obstruct or in any way interfere with floor traffic.



FIGS 38 AND 39. SHELL HANDLING TUBS LIFTED BY CRANES

The shells to be handled, being of a uniform character, the makers, Messrs. Babcock & Wilcox, Ltd., have designed and supplied quite a variety of special appliances for holding them, see Figures 48 to 57.

One is a cradle of inverted channel irons fitted with slings and designed to carry eleven 12-inch shell forgings, see Figure 48. There is also a gripper, Figure 49, for lifting heavy shells from the floor and

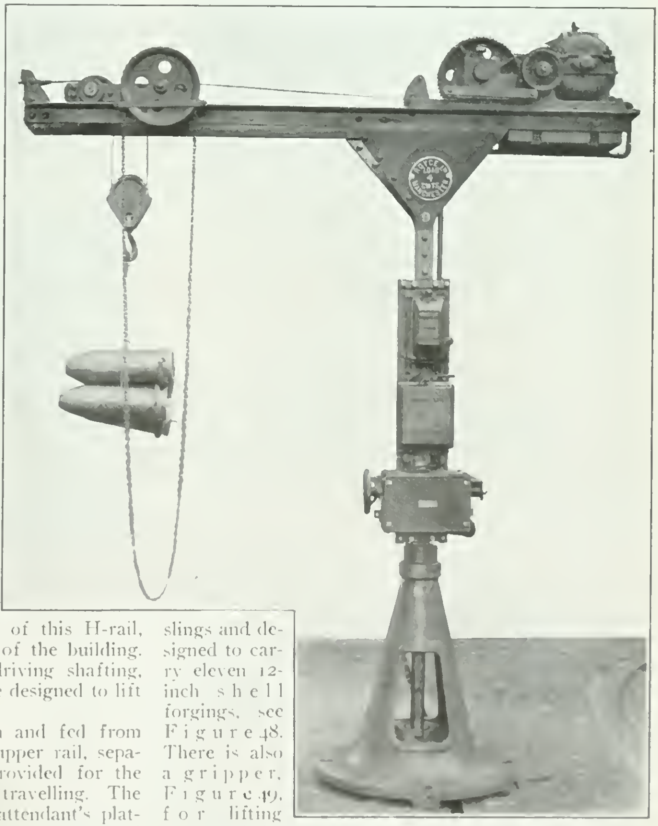


FIG. 40. 4 CWT. JIB CRANE FOR HOISTING BY POWER, SLEWING AND RACKING BEING DONE BY HAND

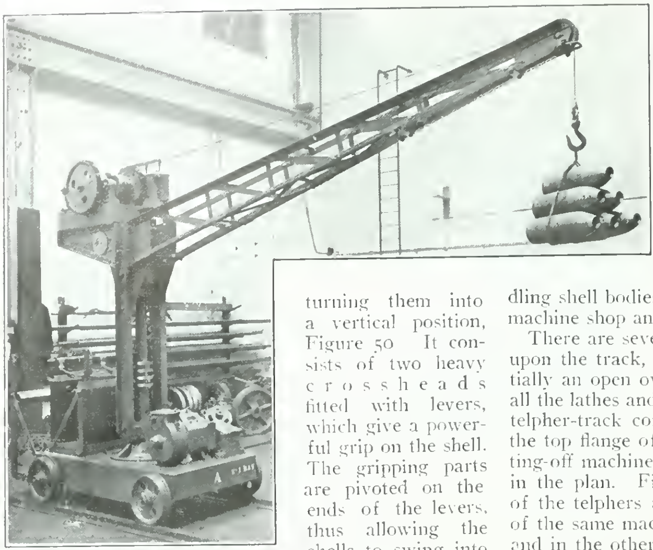


FIG. 41. PORTABLE JIB CRANE FOR HOISTING AND TRAVELLING BY POWER. OVER 70 OF THESE ARE EMPLOYED IN BRITISH NATIONAL SHELL FACTORIES

turning them into a vertical position, Figure 50 It consists of two heavy crossheads fitted with levers, which give a powerful grip on the shell. The gripping parts are pivoted on the ends of the levers, thus allowing the shells to swing into the vertical position. These grips are lined with "feredo" to reduce their tendency to slip.

There is also an apparatus designed to lift four finished shells from the floor, Figure 51. The prongs are so shaped as to pass between an adjoining pair of shells, each ofwhich is thus supported by two prongs. The tongs, Figure 56, are useful for lifting short shells up to 8 inches in diameter, while for larger shells double pronged tongs are employed, see Figure 57.

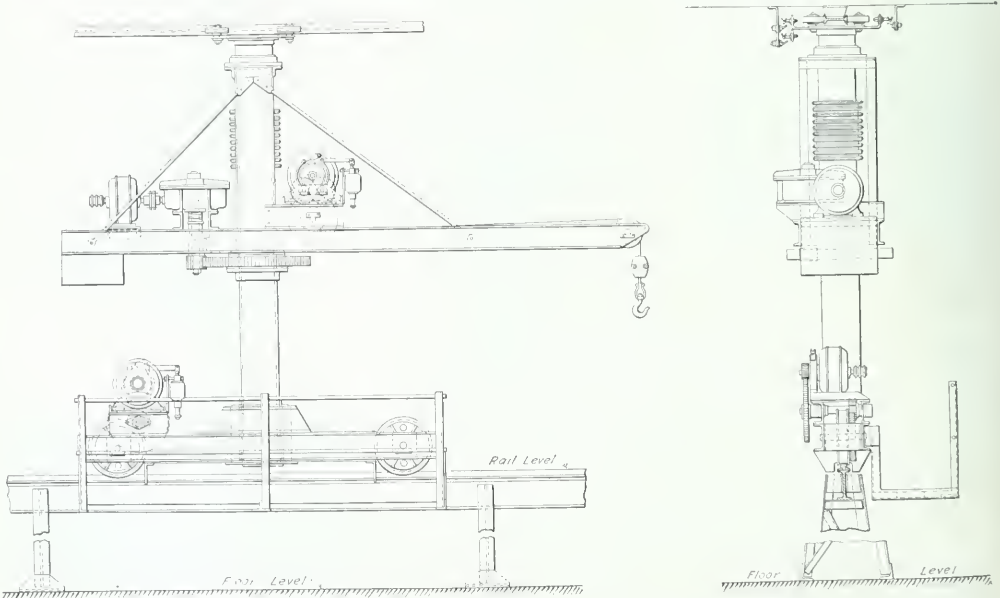


FIG. 42. TWO VIEWS OF TRAVELLING SHELL CRANE, SHOWING OPERATOR'S PLATFORM

TELPHER AND TRANSPORTER

The telpher and transporter are most suitable devices for handling munitions in course of manufacture, owing to their great flexibility. Also owing to their great speed and to the fact that they move in an elevated position and, therefore, out of the way of everything, they are superior to floor transport. An interesting example is a telepher installation in a large munition plant manufacturing 9.2-inch shells. The general layout of this plant may be seen from Figure 58. It was installed in 1916, principally for the purpose of handling shell bodies between the various tools in the main machine shop and has been an unqualified success.

There are seven high-speed telpher machines running upon the track, which as the drawing shows, is essentially an open oval, so chosen that it passes practically all the lathes and cutting-off machines in the shop. The telpher-track consists of a bulb-headed rail clipped to the top flange of 9 x 4 inch beams; the lathes and cutting-off machines are arranged approximately as shown in the plan. Figure 59 shows a line drawing of one of the telphers and Figures 60 and 61 give two views of the same machine; in one it is open for use indoors, and in the other it is closed in for traffic out of doors. The latter machine is at work upon a portion of track outside the shop for the purpose of unloading forgings brought by rail and taken into store, and also for handling finished shells which are outward bound. It will be seen from the illustration, Figure 58, that the end of the telpher track in the shop is broken off, this leads to the store from where the forgings are brought into the shop and to which the finished shells are returned.

The installation was built by Messrs. Strachan & Henshaw, Ltd., of Bristol. The machines are for handling loads of from 500 to 1500 pounds, the lifting speed is 40 feet per minute and that of travelling 400 to 500 feet per minute. Each telpher machine is fitted with two motors of 1¾ hp.—one for hoisting and the

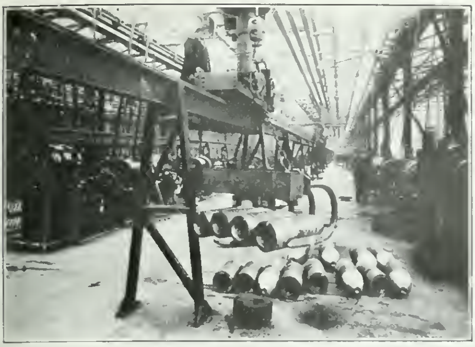


FIG. 43. SHELL CRANE HANDLING 4 SHELLS BY OUTSIDE PRONG LIFTER (SHOWN IN FIG. 51)

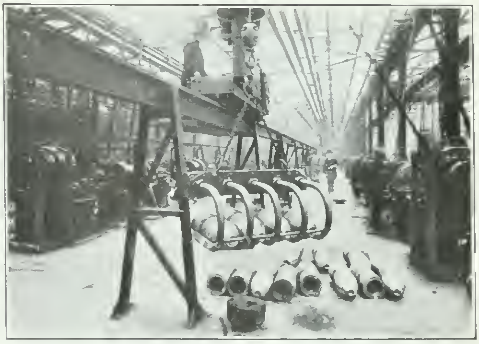


FIG. 44. BACK VIEW OF SHELL CRANE (AS SHOWN IN FIG. 43)

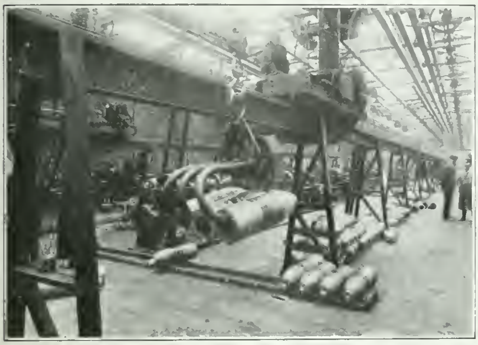


FIG. 45. THREE UNFINISHED SHELLS ON HOOK LIFTER

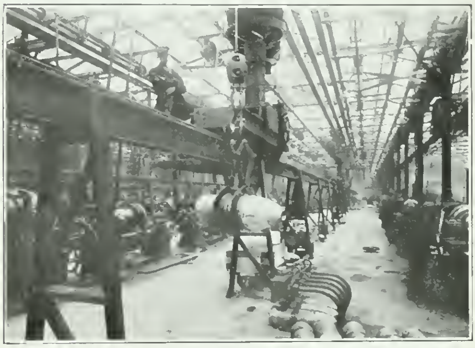


FIG. 46. SHOWING TWO CRANES ON THE TRACK, THE NEAR ONE LIFTING A HEAVY SHELL BY DOUBLE TONGS (SHOWN IN FIG. 57)

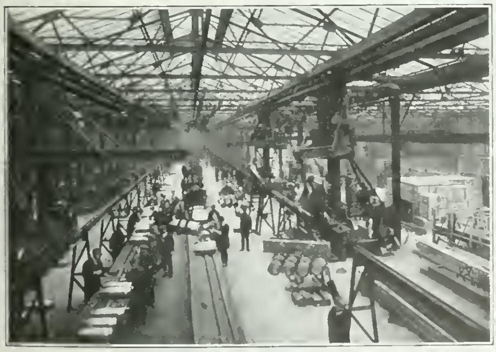


FIG. 47. GENERAL VIEW OF BAY IN WHICH THE FINISHED SHELLS ARE HANDLED BY 4 CRANES ON 2 TRACKS

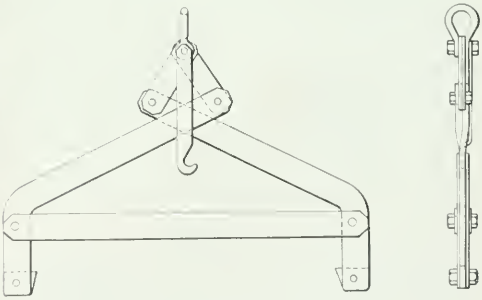


FIG. 49. BILLET GRIPPER

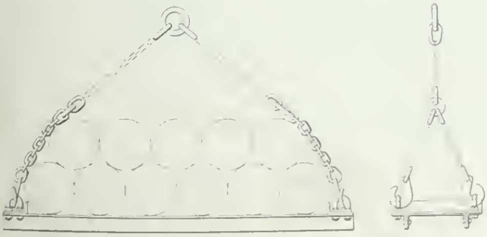


FIG. 48. CRADLE FOR HANDLING SHELL FORGINGS

other for travelling. All the 16 motors of the eight machines are totally enclosed and all parts are interchangeable. The hoisting gear is fitted with an automatic electric magnetic brake, to which is coupled a hand release by means of which the load can be lowered by gravity. An overwinding safeguard is also fitted to each machine which automatically cuts off the current and applies the brake in the event of the operator being negligent when lifting a load. The travelling gear is likewise fitted with an efficient brake operated by a foot pedal from the cabin. These eight machines are all operated by young girls who are skillful drivers and do their work well.

Another installation of a similar nature was installed

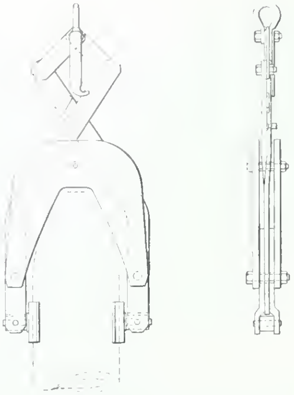
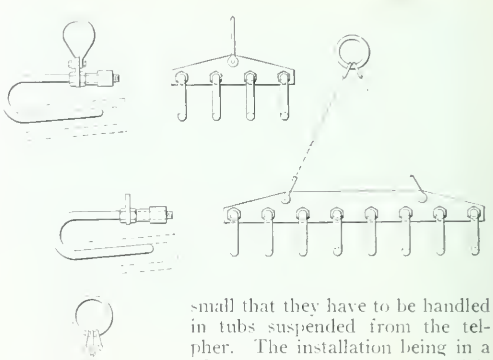


FIG. 50. VERTICAL SHELL GRIPPER



in 1915 in a large munition works, for the purpose of handling small munitions and parts of fuses which are manufactured in enormous quantities. In this case the objects are so small that they have to be handled in tubs suspended from the telpher. The installation being in a Midland town the raw materials are received by car in a store which forms the terminus of the telpher installation, from which the rail track passes through the extensive shops. One of the main duties of this plant is to handle the material to, and the prod-

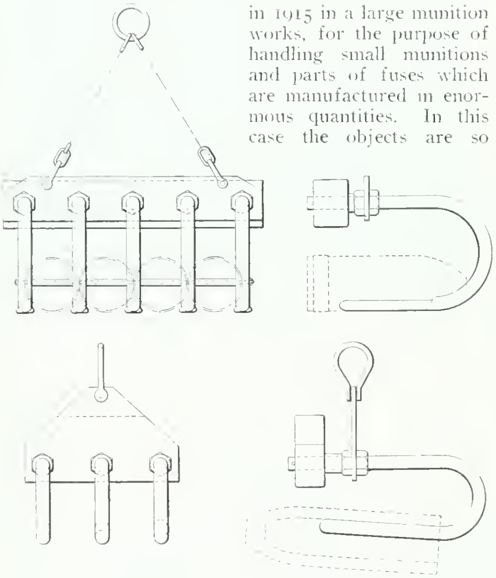


FIG. 51. OUTSIDE PRONG LIFTER AND HOOK LIFTER

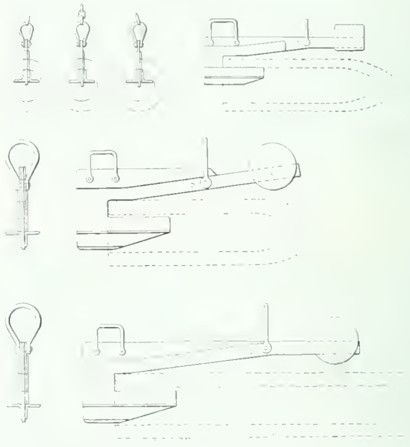


FIG. 52. AT TOP, RAKE FOR 8 SHELLS
FIGS. 53, 54, 55. IN DESCENDING ORDER, GRAPPLING HOOKS FOR SHELLS

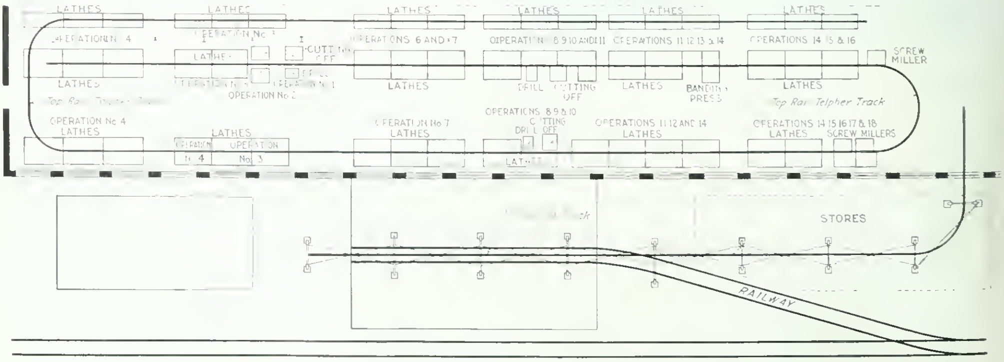
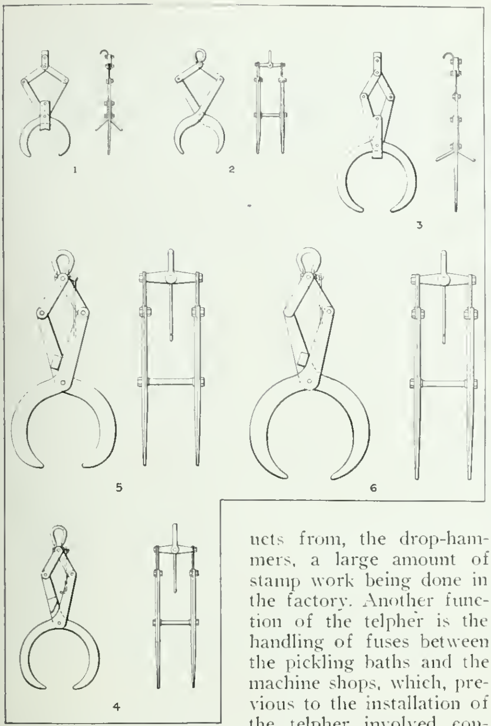


FIG. 58. GENERAL LAYOUT OF A TELPHER INSTALLATION IN A LARGE MUNITION PLANT FOR THE MANUFACTURE OF 9.2" SHELLS



FIGS. 56 AND 57. LIFTING TONGS FOR SHORT SHELLS AND DOUBLE PRONGED TONGS FOR LARGE SHELLS

ucts from, the drop-hammers, a large amount of stamp work being done in the factory. Another function of the telpher is the handling of fuses between the pickling baths and the machine shops, which, previous to the installation of the telpher, involved considerable expenditure of manual labor. As a matter of fact this installation has saved the labor of just about 100 men, according to a statement of the resident engineer made to the writer.

In the general lay-out, not shown in this article for lack of space, the telpher line crosses a public street and this portion is covered in by corrugated iron. Immediately after passing this protecting bridge the telpher track is divided by a switch into two, and forms a loop through the shop, returning again to the same switch. The telpher track consists of a single bulb-rail about 24 pounds per yard, which is clipped to the top flange of a standard 12 x 6-inch rolled steel beam. In addition to this switch in the telpher track and mentioned above, there is another switch which has been added with a recent extension. The switches of this plant are worthy of particular notice. They are of the quick-action, self-locking type; they are easily and quickly operated by the driver and only half a turn of a hand-wheel with the application of a force of about 17 pounds is required to change the switch. One of the most attractive features of this type of switch is that the main track girder is left intact.

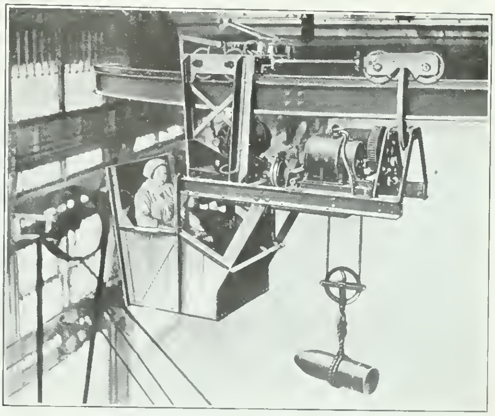


FIG. 60. PHOTOGRAPHIC VIEW OF TELPHER MACHINE ILLUSTRATED IN FIG. 59

Two telpher machines are employed on this track, each with a net capacity of 2500 pounds at a lifting speed of 50 feet per minute and a travelling speed of 500 feet per minute. The installation is at work 24 hours per day and handles 300 tons per week. Three shifts are employed of 8 hours each, one man per shift at $8\frac{1}{2}$d. (17 cents) per hour. This plant has been at work since June, 1916.

The current supply in this case is two-phase, 50 periods and 200 volts. There are two trolley wires above the rail and the track is used as the "return" for the current. There are again 2 motors, each of 6 b.h.p. for each machine, running at 920 revolutions per minute: they also are totally enclosed and interchangeable. The gears are machine cut from steel blanks, the hoist brake being automatic, with a hand release for gravity lowering. The travelling gear consists of a triangular roller chain drive between the motor spindle and the two rear axles. Figure 59 gives two views of one of the machines. The travelling wheels are of manganese steel mounted upon jackmanised steel axles, which are supported in roller bearings each $1\frac{3}{4}$ inch diameter and 5 inches long.

A bottom-flange telpher is also employed, constructed by Messrs. Robert Demster & Sons, Ltd., of Elland, Yorkshire. Telphers of this type are used in British munition works and shell factories.

There are also some neat hand and electric runways built by Pickerings, Limited, of Stockton-on-Tees, equipped with simple hand

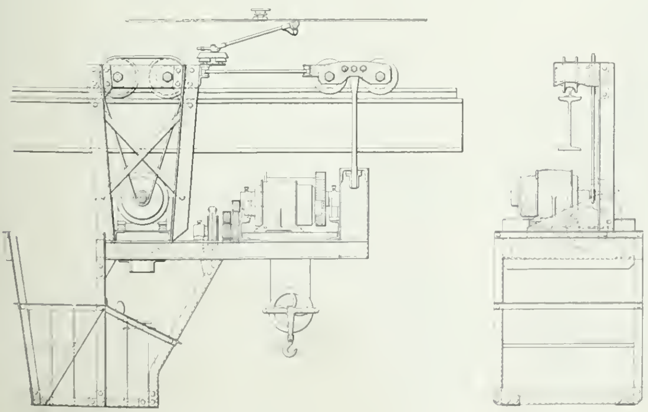


FIG. 59. TWO VIEWS OF TELPHER MACHINE ON TRACK, SEE FIGURE 58

tackle. The electric trolleys are made in sizes of from 500 pounds to 3 tons; they are direct-coupled to an electric motor of the reversible type; the motor drives a worm which gears into a worm-wheel. The worm-wheel runs in oil to give thorough and constant lubrication. The block is operated by means of the rope shown at the right hand of the illustration; when this rope is pulled in one direction the load is lifted, when pulled in the opposite direction the load is lowered, and when the rope is released the controller flies to the "off" position and automatically releases the brake, bringing the load to rest. The lifting gear is provided with a limit switch so that when the load is raised a certain height this gear comes into action and automatically cuts off the current. The runway in the illustration is arranged for hand traversing gear, but such runways are also fitted with an additional electric motor for traversing as well as hoisting.

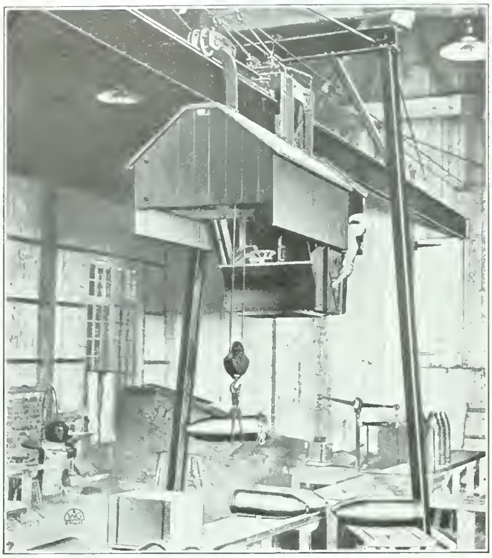


FIG. 61. TELPHER MACHINE, AS SHOWN IN FIG. 59; CLOSED, FOR TRAFFIC OUT OF DOORS

(To be continued.)

Wood for Boiler Fuel

By C. T. Baker

THE present cost of coal and fuel oil, with the possibility of a still further advance in price together with uncertain deliveries, has caused managers and engineers to look with favor toward wood as a substitute in localities where it can be secured in sufficient quantity, and at a price consistent with quality. In certain sections of the South wood can be obtained and is used extensively, particularly in towns that are compelled to pay an all-rail rate on coal from the mines.

To burn wood successfully and economically requires, contrary to general belief, as much careful thought and attention in the fire room as it does to burn any other class of fuel. This fact, however, should not discourage managers and engineers who are favorably situated to burn wood, as any fireman who is properly instructed can, if he uses good judgment, burn wood successfully. The best results are, of course, obtained where the boilers are set high above the grates and where the furnaces are provided with wood-burning grates. For best results with return-tubular boilers, the shell should be located at least 48 inches, and preferably 58 to 60 inches above the grates. With water-tube boilers, a distance of six to eight feet from the grates to the bottom row of tubes will give good results. Each boiler uptake must be provided with a damper for draft control, and the boiler settings must be kept perfectly tight and free from any air leaks.

Draft Gage an Essential

One of the greatest problems in burning wood is to keep down the loss due to excess air, as it must be remembered that wood does not lie as closely or "pack" on the grates as does coal. As the chances for air in excess quantities passing up through the fuel bed from beneath the grates are much better than where coal is burned, the stack damper must be used intelligently, and as a proper guide for draft control a draft gage is essential.

If saw dust is available and can be secured at a nominal cost, its use in connection with wood will be found advantageous, as it will enable the fireman to keep the grates more uniformly covered, thereby reducing the excess air losses above referred to, and at the same time effect a further saving of wood due to the heat value of the saw dust. Regular saw-dust grates can be used to advantage where wood and saw dust are burned together continuously, and, as a matter of fact, should always be used.

Relative Heat Values

Ordinarily, a cord of well seasoned pine wood will equal a ton of coal, having a heat value of say 12,500 to 13,500 B.t.u. per pound. In this connection a saving of 12 to 15 per cent. can be effected by buying wood in excess of the requirements and allowing it to season before using, instead of burning the green wood as it is delivered from the forest. Of course, when making a comparison between wood and coal or wood and fuel oil, the price of each must be carefully considered, and unless the difference in price is very much in favor of wood, it may not pay to consider wood requiring over one and a half cords to equal a ton of coal, although in some cases I have known a saving in favor of wood where two cords were required to equal a ton of coal.

Wood is usually delivered in four-foot lengths, hence it is possible to brick off some of the grate area next to the bridge wall in long furnaces with good results, as furnaces over six feet in length present some difficulty in keeping the grates covered, resulting in excess air losses.

Bridge walls should not be built closer than 14 inches to the shell, in the case of return-tubular boilers, and often 16 inches is better. With water-tube boilers, the bridge wall construction is more or less dependent on the make of boilers and whether or not vertical or horizontal baffling is used.

Use Thermometer in Uptake

Some wood, particularly certain pine wood, when burning leaves a heavy deposit of soot on the heating surfaces; consequently, arrangements should be provided for properly blowing the heating surfaces with steam, otherwise there will be a decided dropping off in evaporation as the gummy soot is often a greater non-conductor of heat than coal soot. A thermometer or pyrometer in the flue gas uptake is a very good investment, constituting an excellent check against dirty heating surfaces.

Deliver Wood on Trucks or Cars

A track for running the cars should be laid between the rows of wood stacked, with a main line to the fire room, as any other manner of delivery in power plants of any size is prohibitive on account of the labor costs. Usually on a properly laid and graded track, one man can handle a cord per load, although with some kinds of unusually heavy wood, three-quarters of a cord is all one man can handle.

TABLE 1—COMPARISON OF OIL, COAL, WOOD AND SLABS AS FUEL

	Oil	Coal	Wood	Slabs
Number of tests	5	5	1	4
Cost of fuel, including freight	$1.19 per bbl.	$4.86 per ton	$3.34 per cord	$2.475 per cord
Cost of unloading fuel at plant (0.04 per kw. hr. for oil)	$0.00671 per bbl.	$0.1177 per ton	$0.085 per cord	$0.1765 per cord
Weight of fuel per unit of measurement (oil taken at 85 F.)	324 lb. per bbl.	2000 lb. per ton	2752 lb. per cord	3500 lb. per cord
Cost per pound for fuel, including freight and unloading	$0.003768	$0.002489	$0.001245	$0.0007576
B.t.u. per pound of fuel as fired	18,732	13,490	8,962	7,740
Cost of fuel per million B.t.u. (including freihgt and unloading)	$0.2011	$0.1845	$0.1389	$0.1095
Net equivalent evaporation from and at 212 F. per pound of fuel (allowing 3.5% for burners in case of oil)	14.245 lb.	9.452 lb.	6.565 lb.	4.0718 lb.
Efficiency of boiler and furnace, using given fuels	76.06%	67.67%	70 7%	51.0%
Cost of evaporating one pound of water	$0.00026451	$0.00026331	$0.00018964	$0.00018606
Cost of evaporating 1,000,000 pounds of water	$264.51	$263.31	$189.64	$186.06
Cost of evaporating 235,000 pounds of water (average 24 hours evaporation)	$62.12	$61.88	$44.57	$43.72
Cost per 24 hours of handling fuel at plant (Coal and wood passers)	....	$3.50	$3.50	$3.50
Net cost per 24 hours of operating with given fuels, assuming that all wood paid for is received	$62 12	$65.38	$48 07	$47.22
Percentage of wood paid for which is actually received at plant	....	....	93%	100%
Net cost per 24 hours of operating with given fuels, correcting for shortage in wood receipts	$62.12	$65.38	$51.43	$47 22

TABLE 2—COMPARISON OF OIL, COAL, WOOD AND SLABS AS FUEL

	Wood Local	Wood By Freight	Slabs	Coal	Oil
Weight of fuel per unit of measurement (oil taken at 85 F)	3432 lb. per cord	2752 lb. per cord	3500 lb. per cord	2000 lb. per ton	325 lb. per bbl.
Net equivalent evaporation per pound of fuel as fired (assuming 3.5% to be used by burners in case of oil)	6.648 lb.	6.563 lb.	4.0718 lb.	9.452 lb.	14.245 lb.
Net equivalent evaporation per unit of meaurement of fuel (assuming 3.5% to be used by burners in case of oil)	22,822 lb.	18,057 lb.	14,250 lb.	18,904 lb.	4.630 lb.
Total Costs at which all fuels would be equally economical under actual operating conditions at this plant	Per cord	Per cord	Per cord	Per ton	Per barrel
	$3.50	$2 77	$2.18	$2.90	$0 71
	4.00	3.16	2.50	3 31	.81
	4.25	3.36	2.65	3 52	86
	4 50	3.56	2.81	3.75	.91
	4.75	3.76	2 97	3 93	96
	5 00	3.96	3 12	4.14	1 01
	5.25	4.15	3 28	4 35	1 06
	5.50	4.35	3 43	4 56	1.12
	5.75	4.55	3.59	4.76	1.17
	6 00	4 75	3 75	4 97	1 22

NOTE:—A car of slabs as ordinarily loaded will average 8.5 cords of 3500 pounds each. This weight of 3500 pounds being applicable to comparatively green slabs, that is, to slabs which were sawed from green timber from five to ten days previous to the time the weights were taken.

The boiler tests given in Tables 1 and 2 are actual tests run on water-tube boilers with vertical baffling, and rated at 250 h. p. The distance from the grates to the bottom row of tubes in the front end of the furnace was 48 inches, and at the bridge wall 40 inches. No saw dust was burned with either the wood or slabs and the grates were the usual coal grates, being approximately 50 per cent. air space. The boilers had standard settings; at the time of their purchase some years ago due consideration was not being given to high settings. In regard to the fuel prices given in the tests, they were those prevailing in 1914, and, of course, do not represent present day prices. However, the prices of slabs and wood in the locality where these tests were made have not advanced in the same proportion as coal and fuel oil, and the burning of wood or slabs now shows a greater saving over coal or oil. Reference in the tests is made to "wood, local" and "wood, by freight." This is because of the difference in weight per cord of the wood available in the vicinity and the weight of the wood shipped in by rail from a distance. It will be noted that the net cost for 24 hours' operation for different fuels is in favor of slabs, with wood coming second and coal third.

A Storekeeping Organization in Russia

Where Means of Communication are Primitive, Truckmen Illiterate and Storekeepers Poorly Educated

By Percy R. Clark

Just now, when all attention is focused on Russia, it is of interest to know of some of the difficulties met with in industrial operations there and the methods used to overcome them. This article takes up the methods and forms used for handling requisitions, recording materials in the warehouse, keeping price lists and following up orders.

Mr. Percy R. Clark *is the only Anglo-Saxon manufacturer in the Caucasus and Russian Central Asia, that is, in that vast region of the extreme southern part of the Russian Empire lying between the Black Sea and the Chinese frontier. He has been in that country eighteen years, and during the past sixteen has held various administrative positions in industrial concerns. At present he is managing director of the Baku Wire Rope Cable Company, Ltd.; managing director of the Ropeways Suspended Rope Railway Company, Ltd., and importer of British and American machinery. In the latter capacity he is the sole agent in his district for several representative American manufacturing firms.*

A Stores Department Organization

THE system described herewith is one I evolved while superintendent of the stores department of a group of petroleum producing concerns in the Baku (Russian Caucasus) district.

Of course the conditions here differ from those obtaining in more civilized parts of the world, but I daresay a few of the readers of Industrial Management have to work under conditions equally primitive.

In developing this system, I had to bear continually in mind the following factors:

1. The oilfields were situated some distance from the head office.
2. Means of communication were primitive.
3. Carters were quite illiterate and storekeepers poorly educated.

I therefore endeavored throughout to reduce writing to a minimum. This is obtained partly by resorting to the well established method of taking several copies of documents at one writing by means of carbon paper; and, secondly, by writing each separate item ordered on a separate form.

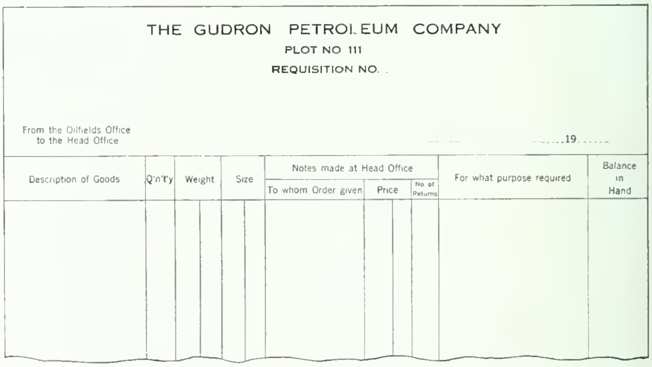
As already mentioned, the head office is situated at some distance from the various oilfields, and is in a fair sized town whence the majority of supplies can be obtained.

Requisitions are written by the storekeepers, a separate requisition for each item. The four copies shown in the illustrations, Figures 1 to 4, inclusive, are taken at one writing by means of carbons.

The requisition, Figure 1, is written by the storekeeper either on his own initiative to bring the quantity of the article in stock up to the normal laid down by the manager, or else on the basis of a requisition received by the store from the chief of some department on the oilfield. This requisition, after signature by the storekeeper and oilfields manager, is sent in to the head office together with the forms of Figures 2 and 3, the latter, of course, being left unsigned.

The requisition, after approval by the commercial or office manager at the head office, is handed on to the superintendent of the stores department. The superintendent files it on a special file kept for this purpose, and this serves as his only record, it being quite unnecessary to recopy the requisition into a separate book, as is sometimes the practice. Recopying, besides creating extra work, is merely an extra source of mistakes.

On the form of Figure 2, the superintendent writes the name of the intended supplier, and, if the item is to be obtained locally, one of the clerks takes the order, together with the delivery note, Figure 3, to the supplier. The requisition, Figure 2, remains with the supplier, and the goods are sent down to the oilfield together with the supplier's delivery note. The delivery note. Figure 3, is brought back by the clerk to the superintendent of the stores department. The storekeeper at the oilfields warehouse will, of course, check the delivery notes with the counterfoil, Figure 4, and the superintendent of the stores department likewise checks his delivery notes

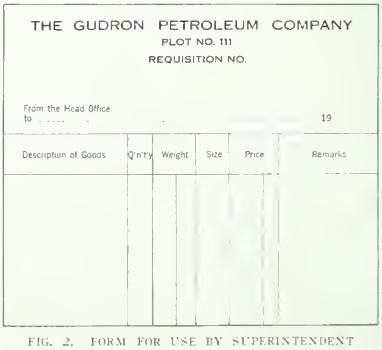


THE GUDRON PETROLEUM COMPANY
PLOT NO 111
REQUISITION NO.

From the Oilfields Office
to the Head Office ....19......

Description of Goods	Q'n'ty	Weight	Size	Notes made at Head Office			For what purpose required	Balance in Hand
				To whom Order given	Price	No of Returns		

FIG. 1. FORM OF REQUISITION FILLED OUT BY STOREKEEPER

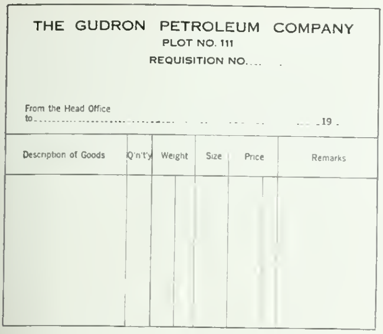


THE GUDRON PETROLEUM COMPANY
PLOT NO. 111
REQUISITION NO.

From the Head Office
to 19

Description of Goods	Q'n'ty	Weight	Size	Price	Remarks

FIG. 2. FORM FOR USE BY SUPERINTENDENT



THE GUDRON PETROLEUM COMPANY
PLOT NO. 111
REQUISITION NO. ....

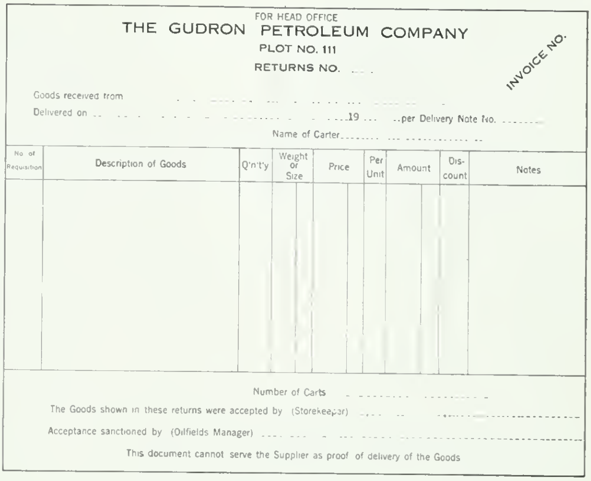
From the Head Office
to .... 19 .

Description of Goods	Q'n't'y	Weight	Size	Price	Remarks

FIG. 3. DELIVERY NOTE TO SUPPLIER OF GOODS

with his file of requisitions above referred to.

Materials, as delivered to the property warehouse, are entered by the storekeeper into a special receipt book in which four copies are taken, viz: Figure 5, receipt Figure 6, returns to the head office; Figure 7, copy; Figure 8, counterfoil.



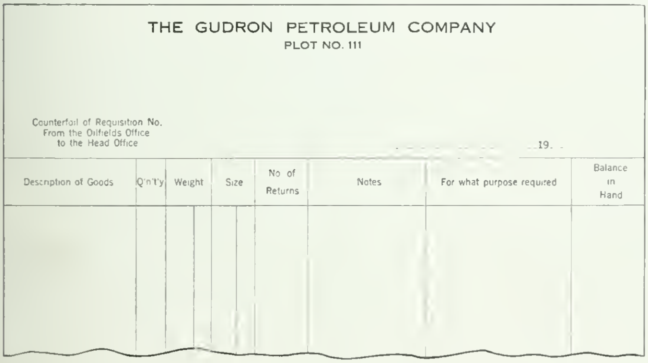
FOR HEAD OFFICE
THE GUDRON PETROLEUM COMPANY
PLOT NO. 111
RETURNS NO. ....
INVOICE NO.

Goods received from ....
Delivered on .... 19 .... per Delivery Note No. ....
Name of Carter ....

No. of Requisition	Description of Goods	Q'n't'y	Weight or Size	Price	Per Unit	Amount	Dis-count	Notes

Number of Carts ....
The Goods shown in these returns were accepted by (Storekeeper) ....
Acceptance sanctioned by (Oilfields Manager) ....
This document cannot serve the Supplier as proof of delivery of the Goods

FIG. 6. RECORD FOR HEAD OFFICE OF MATERIALS DELIVERED

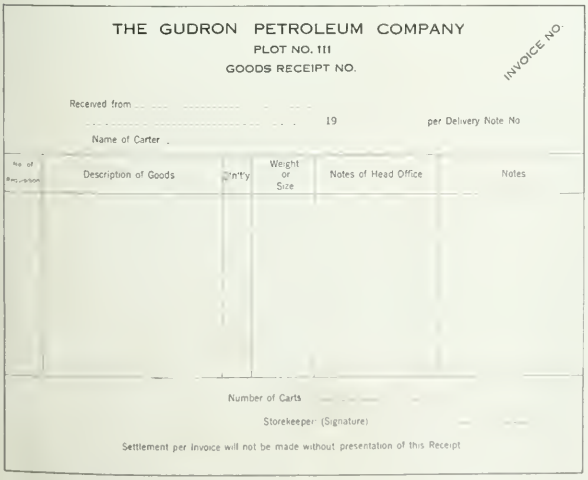


THE GUDRON PETROLEUM COMPANY
PLOT NO. 111

Counterfoil of Requisition No.
From the Oilfields Office
to the Head Office .... 19 .

Description of Goods	Q'n't'y	Weight	Size	No. of Returns	Notes	For what purpose required	Balance in Hand

FIG. 4. COUNTERFOIL OF PRECEDING FORMS



THE GUDRON PETROLEUM COMPANY
PLOT NO. 111
GOODS RECEIPT NO.
INVOICE NO.

Received from ....
.... 19 per Delivery Note No
Name of Carter .

No. of Requisition	Description of Goods	Q'n't'y	Weight or Size	Notes of Head Office	Notes

Number of Carts ....
Storekeeper (Signature) ....
Settlement per Invoice will not be made without presentation of this Receipt

FIG. 5. STOREKEEPER'S ENTRY FORM FOR MATERIALS DELIVERED

The receipt, Figure 5, and copy of receipt, Figure 7, are handed to the carter. He returns the receipt to the supplier, who, in his turn endorses on the copy, Figure 7, that he has received the original receipt, and only on presentation of such signed copy of receipt is the carter paid for carriage. This may seem a somewhat elaborate system, but the main point is you are not relying upon any writing on the part of the carter, who is not to be depended upon in this respect, and still the onus of proving delivery is thrown on him. The obligation on him to deliver up to the superintendent the copies of receipts duly endorsed by the suppliers before he is paid for cartage, is sufficient to keep him up to the mark. Any system which entails the carter signing on for goods and afterward obtaining a separate receipt from the store is inefficient inasmuch as, first, the carters are invariably illiterate, and, secondly, even if in the event of a misunderstanding you have a claim on the carter, it is not worth much.

The returns, Figure 6, signed by the storekeeper and field manager are sent to the stores department of the town office and there checked with the requisitions and delivery notes, the prices being duly filled in by the superintendent of the stores department; the returns are thereupon handed to the accounts department. The counterfoils, Figure 8, serve as the incoming record book for the store. On the above mentioned receipts, returns etc., are shown the numbers of suppliers' delivery notes and requisition numbers.

Dealers' invoices are checked by the accounts department with the above mentioned returns, Figure 6.

Invoices are not finally passed for payment until the receipts given by the storekeeper are returned by the suppliers to the accounts department. Receipt of these documents is duly noted on the invoices.

For deliveries from the warehouses on the oilfields to the various departments, requisitions are given by the head of each department. The storekeeper has a special book of disbursement returns; the disbursement return, Figure 9, is sent to the accounts department while the counterfoil is signed by the party receiving the material. This counterfoil serves as the outgoing record book for the stores department.

From this it will be seen that in the stores each item has to be written up three times: 1, on requisition; 2, on receipt into the store; 3, on delivery from the store. In the stores department at the head office there is no writing whatever to be done beyond the cross-checking of figures and filling in of prices and suppliers' names as above indicated.

In the stores department at the head office, prices are recorded in a loose-leaf book which is divided into the following sections: Iron, steel, technical supplies, lumber, ironmongery and colors, electrical supplies, bricks, harness and fodder. In each section the names of the suppliers are entered in ink in a column running down the left-hand side of the page, and separate columns are set aside for the prices of the leading dealers in each section, while the prices of any other occasional suppliers are fitted in wherever convenient (see Figure 10). The prices, which are liable to constant revision, are written in pencil.

It is advisable for the company to have its own printed forms of price lists for the majority of the foregoing sections in order to avoid confusion in nomenclature, and to ensure getting the quotations for the articles most generally required by the concern. It has to be borne in mind that many suppliers not only have no price lists of their own but are even quite illiterate. I used to keep the following blank price lists: 1. Technical Supplies; 2. Ironmongery and Colors; 3. Lumber; 4. Fodder; 5. Iron; 6. Steel.

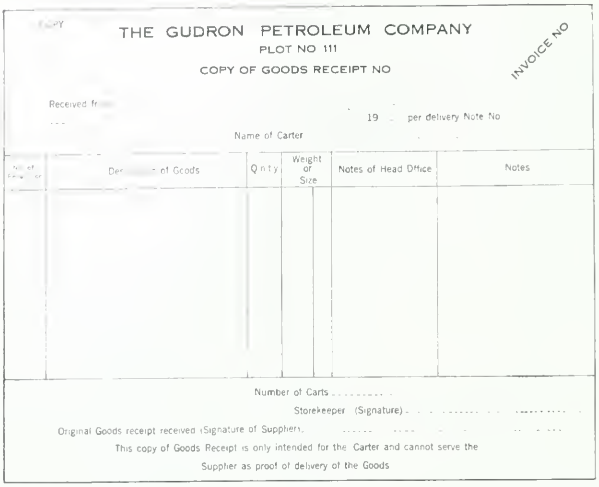
FOLLOW-UP SYSTEM FOR INQUIRIES AND ORDERS

Outgoing orders are followed up by means of the card-calendar which needs no comment.

The following memorandum forms (printed on polygraph) served to keep in touch with suppliers:

1. Inquiry for tender, Figure 11.
2. Reminder that tender not received, Figure 12.
3. Refusal of tender, Figure 13.
4. Reminder that confirmation of order not received, Figure 14.
5. Reminder that order not filled, Figure 15.
6. Reminder that letter not answered, Figure 16.

These need no further comment.



COPY

THE GUDRON PETROLEUM COMPANY
PLOT NO 111
COPY OF GOODS RECEIPT NO

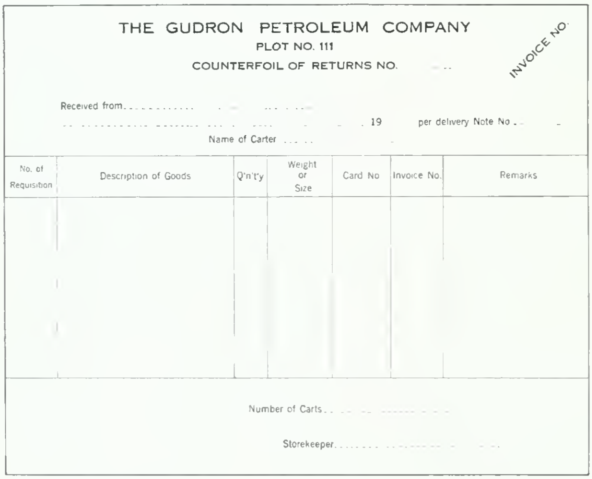
INVOICE NO

Received from
19 per delivery Note No
Name of Carter

No. of Requisition	Description of Goods	Q'n'ty	Weight or Size	Notes of Head Office	Notes

Number of Carts ....
Storekeeper (Signature) ....
Original Goods receipt received (Signature of Supplier) ....
This copy of Goods Receipt is only intended for the Carter and cannot serve the Supplier as proof of delivery of the Goods

FIG. 7. COPY OF RECEIPT FOR ENDORSEMENT BY SUPPLIER



THE GUDRON PETROLEUM COMPANY
PLOT NO. 111
COUNTERFOIL OF RETURNS NO.

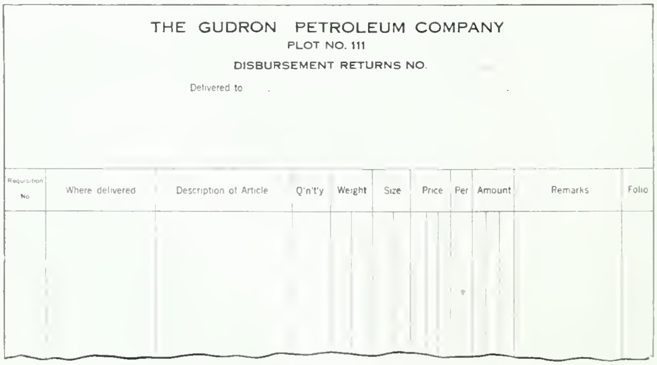
INVOICE NO

Received from ....
.... 19 per delivery Note No ....
Name of Carter ....

No. of Requisition	Description of Goods	Q'n'ty	Weight or Size	Card No	Invoice No.	Remarks

Number of Carts ....
Storekeeper ....

FIG. 8. COUNTERFOIL OF FORMS SHOWN IN FIGS. 5, 6 AND 7



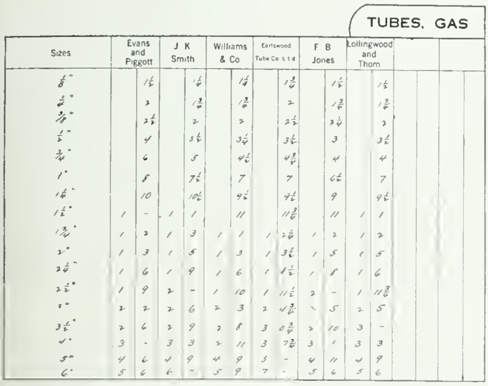
THE GUDRON PETROLEUM COMPANY
PLOT NO. 111
DISBURSEMENT RETURNS NO.

Delivered to

Requisition No	Where delivered	Description of Article	Q'n'ty	Weight	Size	Price	Per	Amount	Remarks	Folio

FIG 9. DISBURSEMENT RETURN FOR ACCOUNTING DEPARTMENT

In the warehouse a record of materials is kept on the card system. A fresh card is commenced for each consignment of each separate article, (see Figure 17) and the disbursements are entered below until the whole consignment has been written off.



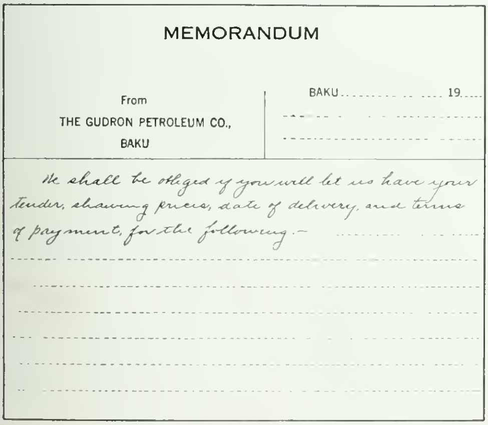
TUBES, GAS

Sizes	Evans and Piggott		J K Smith		Williams & Co		Earlswood Tube Co Ltd		F B Jones		Lollingwood and Thom					
1/8"		1½		1¼		1¼		1¾		1½		1½				
1/4"		3		1¾		1¾		2		1¾		1¾				
3/8"		2½		2		2		2½		2¼		3				
1/2"		4		3½		3¼		3½		3		3½				
3/4"		6		5		4½		4¾		4		4				
1"		8		7½		7		7		6½		7				
1¼"		10		10½		9½		9½		9		9½				
1½"	1	-	1	1		11		11¾		11	1	1				
1¾"	1	2	1	3	1	1	1	2¼	1	2	1	2				
2"	1	3	1	5	1	3	1	3½	1	5	1	5				
2¼"	1	6	1	9	1	6	1	8½	1	8	1	6				
2½"	1	9	2	-	1	10	1	11½	2	-	1	11¾				
3"	2	2	2	6	2	3	2	4¾	2	5	2	5				
3½"	2	6	2	9	2	8	3	0¾	2	10	3	-				
4"	3	-	3	3	2	11	3	7¾	3	1	3	3				
5"	4	6	4	9	4	9	5	-	4	11	4	9				
6"	5	6	6	-	5	9	7	-	5	6	5	6				

FIG. 10. SHEET FROM LOOSE LEAF PRICE BOOK

The following instructions are issued in connection with the form shown in Fig. 2:

"In the event of goods being delivered of quality or sizes which do not correspond with the terms of this requisition or with samples provided by the supplier, the latter must take the said goods back and re-imburse the company for all losses arising from such incorrect delivery, and the company reserves to itself the right to cancel this requisition without any liability whatever towards the supplier. In the event of the supplier delivering a larger quantity of goods than requisitioned, the company has the right to reject the surplus and all losses arising from the delivery of the surplus will be borne by the supplier.



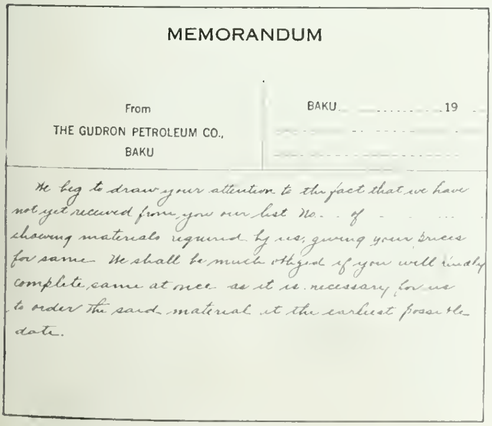
MEMORANDUM

From
THE GUDRON PETROLEUM CO.,
BAKU

BAKU.................19.....

We shall be obliged if you will let us have your tender, showing prices, date of delivery, and terms of payment, for the following:—

FIG. 11. FORM FOR INQUIRY FOR BIDS



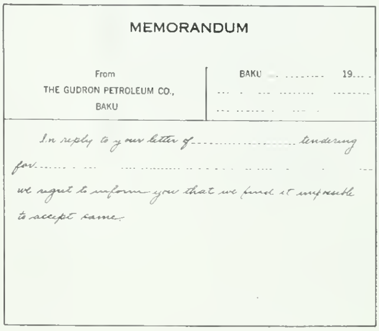
MEMORANDUM

From
THE GUDRON PETROLEUM CO.,
BAKU

BAKU.................19

We beg to draw your attention to the fact that we have not yet received from you our list No. .. of .... showing materials required by us, giving your prices for same. We shall be much obliged if you will kindly complete same at once as it is necessary for us to order the said material at the earliest possible date.

FIG. 12. FORM SHOWING NON-RECEIPT OF BIDS



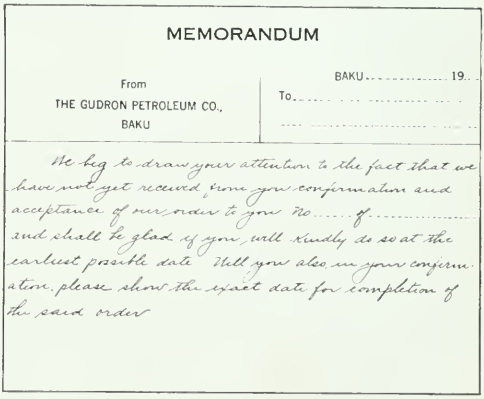
MEMORANDUM

From
THE GUDRON PETROLEUM CO.,
BAKU

BAKU.............19....

In reply to your letter of.......................tendering for...
we regret to inform you that we find it impossible to accept same.

FIG. 13. REFUSAL OF BID



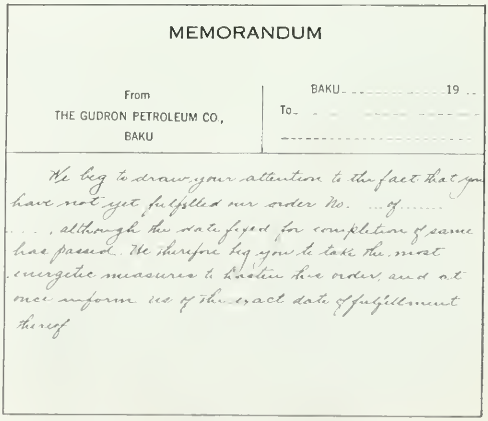
MEMORANDUM

From
THE GUDRON PETROLEUM CO.,
BAKU

BAKU.................19...
To.......................................

We beg to draw your attention to the fact that we have not yet received from you confirmation and acceptance of our order to you No......of..................
and shall be glad if you will kindly do so at the earliest possible date. Will you also, in your confirmation, please show the exact date for completion of the said order

FIG. 14. FORM FOR NON-RECEIPT OF CONFIRMATION



MEMORANDUM

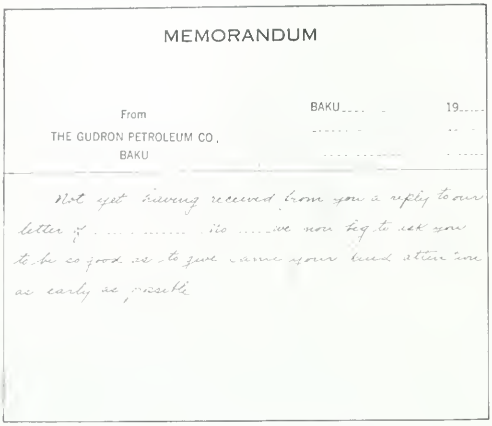
From
THE GUDRON PETROLEUM CO.,
BAKU

BAKU.................19..
To.......................................

We beg to draw your attention to the fact that you have not yet fulfilled our order No. ...of...... ...., although the date fixed for completion of same has passed. We therefore beg you to take the most energetic measures to hasten the order, and at once inform us of the exact date of fulfillment thereof

FIG. 15. REMINDER FOR UNFILLED ORDERS

In the event of the company giving the supplier a sample, such sample must be returned to the company with the first consignment of such goods supplied.



MEMORANDUM

From
THE GUDRON PETROLEUM CO.
BAKU

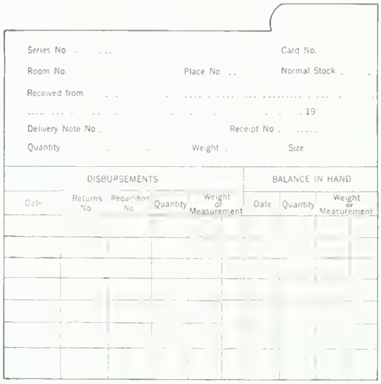
BAKU .... 19....

Not yet having received from you a reply to our letter of .... No .... we now beg to ask you to be so good as to give same your kind attention as early as possible

FIG. 16. REMINDER FOR LETTER NOT ANSWERED

Immediately on delivery of the goods delivery notes with prices must be given to the superintendent of the stores department at the head office.

Acceptance of goods takes place exclusively on the oilfields.



Series No .... Card No.
Room No. Place No .. Normal Stock ..
Received from ....
.... 19
Delivery Note No . Receipt No . .....
Quantity Weight . Size

DISBURSEMENTS					BALANCE IN HAND		
Date	Returns No	Requisition No	Quantity	Weight or Measurement	Date	Quantity	Weight or Measurement

FIG. 17. FORM OF CARD FOR NEW CONSIGNMENT

A receipt for the goods shown in this requisition must be obtained by the supplier for the store to which the goods were delivered. In the event of a receipt not being given for the goods, the supplier is to notify the company in writing within two days of delivery of the goods.

The present requisition can in no case serve as proof of the receipt by the company of the goods shown in the same.

Invoices for the goods delivered to the company must be handed in to the head office not later than the 5th of the month following receipt of the goods.

Payment per invoices delivered after the 5th of the month will be postponed to the following month.

On the invoices the supplier must show the number of each receipt (for goods) and from which store such receipt is given.

On settlement of the invoice all receipts for goods must be handed in to the head office.

Two Short Operations Better Than One Long One

By Aldabert R. DeKuzelewski

IT happens quite often in shops that manufacture more than one type of machine, that one department is over-crowded with work while another is not up to full capacity; or though the office has plenty of orders on the books, one department cannot get out enough work and stops the entire stream of production. Many shops are confronted by this trouble, and if you ask any one how to get out of the difficulty you invariably get an answer and many reasons to the effect that there is simply no way out of it. If you go further and start to analyze and investigate you will see that most of the reasons are merely excuses, certain things can be done if there is any one with enough energy and ambition to try.

Some time after the war started in a shop manufacturing very good machine tools—in the early days of January, in fact—everybody around the works knew that we shipped only 210 lathes, and that the monthly bonus was dropping down, perhaps to 10 per cent. which was the minimum. Everybody was inclined to be pessimistic and some one even said that while passing the main office he heard the gentleman who had the corner room speak quite loudly. It was generally unpleasant for all, but two men had to stand the most of it: The production manager who was rushing the product through the shops, and the master mechanic who was responsible for the efficiency of every department. The latter was a young, aggressive fellow always on the go, always ready to try the impossible, and he had the worst of it.

The situation brought him to the production manager's desk with a dozen right-to-the-point questions. These showed that there were plenty of parts in the finished stock room, that there were more beds already for assembling than were wanted.

Too Few Nine-Inch Hand Wheels

The only reason, or excuse was that the unit department could not get enough complete aprons assembled for the lack of nine-inch hand wheels. Then why in the world did we not run more nine-inch hand wheels, especially as it is a standard size used on practically every type and size of machine? The answer: It took 17 minutes to polish a nine-inch hand wheel, which meant that it was absolutely impossible to run more than 200 at a time on account of lack of space in the polishing department. Indeed this department, located in a dark corner of the shop, was overcrowded with machines; when laying out the shop no one thought there would ever be much polishing to be done. Now 200 hand wheels, neatly put up on stands, 20 on each, were really taking up all the space between the machines. Other parts coming along to be polished could not even be started.

The aggressive master mechanic started to analyze the polishing of the hand wheels and it occurred to him to ask, why was the polishing done on a lathe instead of on a regular polishing wheel. There was an excuse for this also, the inspector would not pass anything but circular polish on hand wheels regardless of the fact that it took 17 minutes to do it, besides the purchasing department would never get the right kind of polishing wheels and so on—mere excuses.

The master mechanic took a chance, tried one hand wheel then another on the polishing wheel. It took only three and a half minutes to finish one. They looked O. K. to him, even a little brighter than the hand wheels finished the old way. So he ran through the entire lot of 200 and the inspection department did not even see the difference.

The next lot of hand wheels was 600 pieces. It took some time to show the production manager that they would not congest the polishing department, that he would save twice the time of setting up on the turret lathe, broaching machine, and so on down the line. And both men found out once more, that if on a given piece the time for one operation greatly exceeds the time of all the other operations, there is a condition that may bring trouble. *It is always better to have two short operations than one long one.*

Too Few Lathe Aprons

A few weeks later another peculiar thing happened in the same shop. The unit department had plenty of parts of all kinds except apron castings—the double-wall apron castings which were the pride and joy of the entire shop. Of these there were not enough machines and that was the end of it. The master mechanic went after the trouble again, and found that the drilling of all the holes in the apron casting was done in one jig—it took one hour to drill one casting complete, which meant a production of ten complete castings daily, and the night man could only make four or five. As this particular apron casting was used on four different models there was no way out of it, except building a new jig at a cost of several hundred dollars and see to it that the work from both jigs, the old and new, would interchange. Not an easy job!

Crowding too many operations into one jig simply reduces the capacity of the entire shop, outside of the fact that it makes the jig more intricate and its operation more difficult. Again he found the same old rule which everybody knows and most forget. *It is better to have two short operations than one long one.*

Chucking and Grinding Troubles

There were some other troubles in this machine shop, the main one being that the chucking lathe department and grinding department could not get out enough work to keep the other departments going at full speed. But this was an easy problem for the aggressive master mechanic. He transferred the work which was nothing but straight boring without any turning into the drill press department. Of course, it took some money to build new jigs and piloted bars, but this was offset by the fact that the drill press department was using the cheapest kind of help, and we had a foreman in this department who could break in any inexperienced boy.

In the grinding department the solution was still easier; we simply set the limits closer on the finishing lathe operations and that was the end of the trouble.

Problem of Returned Soldiers

By S. A. Goldsmith

WHILE Churchill's statement, "Look after the war and after the war will look after itself," did obtain until recently, the advent of the reconstruction policy of the British Labor Party has changed the situation. It is not that British labor is attempting to force the hands of its government, so much as the fact that it is directing the attention of all thinking persons to the labor situation, particularly to the employment problem after the war.

Among other things, British Laborites direct the attention of governments to the necessity for increasing tremendously the numbers of labor exchanges or public employment offices. With reconstruction in Great Britain almost 8,000,000 wage-earners may find themselves in a shifting market.

It is quite possible that in the United States more than that number may be affected. Irrespective of the number of women now participating in war industry, at least 5,000,000 able-bodied soldiers and sailors will be affected by peace on the present army and navy plans. With the Government calling immediately for 300,000 men for the technical and special branches of the army service, the problem is brought more closely home to industry.

Two Classes to be Considered

There are two classes of skilled or unskilled men that the reconstruction, or readjustment (a better term, perhaps) period will have to handle. The first is the disabled "returned," and the second the able-bodied "returned." For the disabled, the Government will endeavor to institute a rehabilitation program whose intent is to give to such men a means of earning a livelihood. For the able-bodied ex-soldier there will possibly be an extension of public employment service. Yet, the Government cannot prosecute this dual program without a conscious, provident coöperation on the part of industrial executives. And the coöperation should be planned now, particularly by employment managers.

Our discharged soldiers will have been not only subjected to a life of nervous tension which may unfit many for a return to highly skilled positions, but they have been used to spending a considerable part of their time out-of-doors. Disciplined as they will be, yet will they readily adjust themselves again to work that is repetitious, done indoors, and lacking often in exhilarating excitement?

Three Things to do Now

What can employment managers and leaders of industry do to plan to meet the problem now?

1. For the disabled soldier, machines have helped solve many a problem that would have been beyond solution years ago. When readjustment comes and the Government's rehabilitation program is in full swing, employers should plan to use disabled men for mechanical work at machines. Many a man who has lost a leg can be appropriately and profitably employed at a machine where the use of hands and arms alone is needed. Even the blind have done and are doing miraculous things at machine work that requires only mechanical, standardized movements of the body. What may be required, perhaps, will be a more frequent inspection of the machinery and adjustment of parts and tools. That, however, will work for higher mechanical efficiency.

2. For the able-bodied men, one thing might be profitably done during the war. Employment managers and industrial executives might now keep in touch with their skilled workers in the armed forces of the United States. The plant should show interest, not only in their well-being, but also in their industrial welfare. A skilled mechanic, absent for a long time from the shop, will lose his feeling of being one of the organization.

3. In the period of readjustment, it is commonly held that some sort of system of bonuses or profit-sharing will be employed necessarily to offset any decrease in wages and at the same time speed up production. With the returned soldier, such a system will be more than necessary to give him that requisite element of exciting competition that will keep him to his task consistently and permanently. Employers should consider this factor among others in planning for the coming wage adjustments.

Employment Department Organization of Thomas A. Edison Interests

By Mark M. Jones

This installment of Mr. Jones' series shows the position that the employment department should occupy with reference to the factory management, the executives and the workers. It tells how his own department is organized and built up, and is filled with helpful hints as to methods to be followed in obtaining prospects, selecting applicants, arranging for transfers and maintaining cordial relations in case of dismissal.

Mr. Mark M. Jones' *early experience included the position of street car conductor, clerk and chief clerk in the traffic department of a street railway company in Waterloo, Iowa. Later he was traffic manager of the William Galloway Company. Relocating in California, he held several positions connected with traffic, finally becoming industrial secretary of the Oakland Chamber of Commerce. In 1916 he came East, to undertake his present work as Supervisor of Personnel of the Thomas A. Edison Interests at Orange, New Jersey.*

EMPLOYMENT is the main function of an industrial personnel department. It is so vital that much of the success of the department depends upon the manner in which the associated problems are handled.

Fascinating in many details, as humanity's ramifications provide the complexities of thousands of questions which employment experts must settle intelligently and with despatch, the department also has serious responsibilities. Workers must be secured before rates are set for their work, before safety campaigns are inaugurated, activities for betterment and improvement of working conditions organized, or hospitals set up. The deep humanizing sentiments that underlie the working side of industry today challenge the best employment intelligence available. Patriotic necessity, too, focusses attention upon the need of keeping production up to the top notch of service and the transfer of employment responsibilities from the executives, who formerly hired all their help, to personnel departments has switched over to another track a long train of conditions that are today being revised advantageously to industry and workers alike with benefit to both parties.

An employment department, using a shop parallel, is both a purchasing and a stores department. It must know where human assistance—men and women—can be secured to meet the needs of the factory. It must select this assistance with care. It must classify and arrange. The department records of men and women who are available are like the compartments of a storeroom, and from them whatever is needed can be taken as called for. But dealing with human assistance is a far more delicate task than handling materials.

The coöperation of executives with personnel departments bids fair to aid in marking out dependable employment pathways that will make for closer coöperation of all branches of big organizations in the serious business of maintaining harmonious relations between employing companies and workers.

The organization of the employment function is a natural first step in successfully administering an industrial pay-roll. In our case we set out to make an intensive study of the personnel problems of the Thomas A. Edison Interests. We believed that an employment office should be a purchasing department for human services, and should be manned by a staff of men and women with broad human sympathies. It should serve as a station where the human tide flowing in and out of the various Edison Interests could be sifted in accordance with the limits imposed by market conditions. In the process of sifting we sought to organize and set up one labor policy for all the Edison Interests.

EMPLOYMENT OFFICE A STOCK ROOM

Where an employment office such as ours is organized for the service of a great many functions, it takes on the aspect of a large central stock room, except that instead of having materials on the shelves its stock consists of the services of men and women. The point at which there is a demand for help makes the demand known through the issuance of a personnel requisition, which upon receipt at the central stock room or employment office is filled and the desired human assistance sent to the function making the request. When times permit or warrant the maintenance of a file of prospects, this file represents bins in the stock room from which properly classified human assistance is drawn to fill requisitions.

When the demand or need for human assistance ceases in any one particular function, that fact is indicated by filling out a "return" which has the effect of releasing the individual from the function and returning him to the central stock room. This process is followed regardless of the reason for sending the person back, whether it be on account of lay-off, dismissal or leaving for some other reason. If upon return to the employment office the facts warrant doing so, the person's services are again placed in stock in the proper bin ready to be sent out on other requisitions. This plan offers the opportunity for a large number of transfers, and obviates the expense that would otherwise be incurred for individual activity on the part of each department wishing help. It provides one central marketplace for the meeting of supply and demand for a large number of independently operated units.

The reduction of labor turnover is one of the main purposes of a personnel department, yet by a strange coincidence our own employment function has had the unique experience of passing through a period of high labor turnover. This is due to our policy of engaging persons whose qualifications were such as to make them of value to the Edison organization and placing them on personnel work, although positions for which the particular persons seemed fitted were not open at the time they were engaged. They were thereby held in reserve and had the advantage of intensive study of the Edison personnel policy up to the time when they were finally transferred to positions they now occupy.

An Employment Department Serves Three Masters

An employment department must serve three masters, management, executive and worker. In behalf of the management, the employment office must so conduct its affairs that one policy is applied on employment matters for a large number of different functions. For the executive, the employment department must secure the kind of human services desired as expeditiously as possible and on the basis of its intimate touch with workers, keep the executive informed of any condition which may develop through its contact with his workers or which may affect his particular department through other sources.

To the worker, the employment office must stand in the position of the people's lawyer. It should be ready to represent him at any time when he may have the need for impartial and disinterested assistance. Where the facts seem to warrant, it should present the worker's case at the court of the proper executive in an impartial and disinterested manner. Should the circumstances not warrant taking up the case, it should clearly point out to the worker the reason why. If convinced that the worker should be dismissed, the department should "sell" a dismissal by carefully presenting the case to the person affected. It is most difficult to convince a person of the error of his ways, yet much may be done to soften the blow and avoid the resentment harbored by the worker who leaves without having all the facts carefully paraded before him in a skilfully organized manner. Experience shows that it is well to use the same care in dismissing that is used in engaging. It is a matter of human relations that extends out into the community and it does not require a large number of unjust dismissals to set up a reputation for an industry that will take many years to overcome. A reputation of that sort has an important bearing upon the class of men applying for positions, and as much care must be exercised in releasing men or allowing them to leave the organization as was used in getting them into the company's employ.

At the Thomas A. Edison Interests, the Employment Service Department was set up two years after the fire which destroyed a number of buildings, and its first problem was that of organization. At the same time it was necessary to keep operating and to supply all demands. Methods had to be developed and improved at the same time operation was being carried on. It was a process similar to the rebuilding of a bridge with trains passing over it at all times. Up to that time most employment was carried on by the individual departments and divisions. Some had employment clerks, while most handled this particular class of work as a minor activity in connection with many other daily duties.

Group of Interests Served

In carrying into effect the Edison Policy of centralizing the handling of matters of common interest to separate and independent companies, our first step was to centralize entrances and exits for applicants, so that they passed though the proper employment offices. Our main employment office was established at Orange and served the larger plants. A branch office was set up at Silver Lake for another group of plants, and as it is but three miles distant from headquarters, it has been operated in very close conjunction with the main office. The Employment Service Department thus became the service agency of the following:

The Laboratory of Thomas A. Edison
The Edison Storage Battery Company
Edison Phonograph Works
Thomas A. Edison, Incorporated

Each of these divisions has a large number of departments, so that the net result was to establish one central employment agency for the benefit of over 90 manufacturing and administrative units.

In addition to this, it became an advisory agency with services available upon request to other Thomas A. Edison Interests not located at Orange or Silver Lake, N. J., such as the Edison Portland Cement Company, the Wisconsin Cabinet & Panel Company, and others.

A standardized method of accounting in connection with entrances and exits had been lacking, and our next problem was so to focus information as to give us complete accurate detailed data with respect to conditions in each of these functions.

First Engaged Workers for Manufacturing Positions

The employment office was first organized for the engagement of men for manufacturing positions. It then took up the employment of women for manufacturing positions, and later the employment of all persons for clerical and executive positions. The effect has been to require any individual going on the pay-roll of the Thomas A. Edison Interests to pass through the Employment Department. Uniform application of this policy has been necessary to give us the proper information with respect to conditions in widely scattered functions. Coördination of this sort is a difficult thing, but we have had most generous coöperation from various function heads and feel that we have made excellent progress in this respect. The status of the employment office in our case is different from that of the average employment office in an industry where the general manager is the one supreme power. On account of the great diversity of operations and interests, the Edison employment department has been required to serve a number of general managers and division managers, and for that reason has had to proceed more on the basis of persuasion than might otherwise have been necessary. It could not be in the position of directly representing any one manager in an executive way. The development of a specialized function, such as employment, is just as much a matter of selling as the placing of some tangible product on the market. In organizing an employment office you are marketing service, and the staff of the office should at all times hold that point in mind. Salesmen often prove excellent men in employment offices.

The most important relationship of the employment office is with the foreman or department head. The foreman is the "king pin" in the average industry, and to workers he represents the management. Whatever policy he enforces is taken to be the policy of the firm, and it is coming to be realized that more and more attention must be given to the foreman and his training and record in the company's service.

Employment Office Must Have Policy of Leadership

In connection with our research on the matter of personnel development, it has been evident in many cases that the employment office of other industries has started off with the idea of showing the foreman "where to get off," practically charging him with incompetence and inefficiency. It should be apparent to anyone that a salesman would not approach a prospect in the same manner, and the result has often been a direct conflict between the two agencies, with a further result of delay in reaching the day of truly efficient cooperation. In those industries where the employment office is the direct representative of the general manager, and practically stands between his office and the foreman, it is no less important that the policy of leadership so far as the employment office is concerned, be followed than in those industries where the employment office is in a coördinated status with the division manager or foreman. Leadership is the crying need of American industry today; it is necessary in every level of industrial executive responsibility. It must extend from the top to the bottom and must be builded upon the sales spirit.

Layout of the Employment Office

The layout of an employment office is an important matter. It depends on whether you are starting with the limitations of existing facilities, or whether you have an opportunity to have buildings erected after being planned for your specific purposes. In our case we have taken existing facilities and developed them for the specialized services required.

The laying out of an employment office is as much a problem in maintaining a proper flow of production as is the laying out of a factory building. You start at one end with your raw material, the applicant, and turn him out at the other end a finished product in the guise of a candidate who has been accepted under your employment standards and recommended to the department executive for engagement. In the Thomas A. Edison Interests the final acceptance of a candidate and setting of the initial rate of pay is in the hands of the foreman or department executive; and the employment office is in the position of recommending individuals to the foreman or department executive.

In some industries the employment office engages a man outright and the department executive has nothing to say about it. We have felt that this would not be in keeping with the democratic principles upon which the Edison organization is founded, as we have hardly believed it logical to hold a department executive responsible for results when he has to depend upon workers not of his own choice. This is a matter of policy, however, and would depend largely upon whether a high percentage of skilled help is used or not. For clerical help or highly skilled workers the foreman or department executive should in all cases have the final settlement of the question of employment. For unskilled workers this is not so important, although it is believed that a much better feeling is created if a foreman is given the opportunity of finally passing upon his applicants.

The working out of this principle is a question of whether you are at the organizing stage or in the operating stage, some time after you have finished organization. At the outset the executive would naturally be suspicious of the new centralized function and would resent anything appearing to represent curtailment of his so-called "authority." Later on, if his confidence in the employment function increased, he would undoubtedly be willing to allow it to take greater liberties than otherwise.

The methods applied in our employment work have changed with the increase in volume of work passing through the department. No attempt was made to extend the service over all Edison Interests at once, but rather to develop slowly, so that our methods were necessarily founded on broad principles sufficiently elastic to be extended as demands grew.

Development of Prospects

We have secured workers through four principal media. First has been the recommendation of workers already in our service. This is by far the most desirable and secures results second to no other method. Workers so secured usually stay and are more dependable than those who come from other sources.

Employment agencies are of varying degrees of helpfulness, depending upon whether they are used for manufacturing help or for clerical and executive positions. The results secured from agencies vary, of course, with the agency and depend upon whether it is a private or public institution. We have had fair results through the use of the Federal and State employment agencies located in this section, and believe that when they are completely organized they will be a most useful instrumentality. We have hesitated to use private agencies when a worker who might be placed in a position at an hourly rate was required to pay the agency for securing his position. In such instances we have preferred to advertise, rather than secure men in that manner, believing that it should not be necessary for such an individual to buy his position. In connection with the clerical and executive positions, however, we have found private agencies to be helpful and have felt that in most cases their services warranted the collection of the small fee required from persons who registered with them. The efficiency of agencies has proved to be largely a matter of market conditions. Where the supply of labor exceeds the demand, a greater opportunity for selection exists and the results are more satisfactory. Where the demand exceeds the supply their services are of less value, as they must send you the nearest approximation to the requisition you may file with them.

Newspaper advertising as a source of applicants is also very much a matter of market conditions. Where the supply exceeds the demand, conservative well placed "want ads" are helpful. As you move from a cycle of excessive labor to one of shortage, the amount of advertising necessary to produce a given result increases and the layout of the advertisement, as well as the material in it, must be correspondingly improved. For the everyday requirements of the average industry, it is oftentimes found that advertising on certain days of the week is of no benefit whatever. This point must naturally be studied in the light of local conditions, and if well done will be favorably reflected in your bill for advertising at the end of the month. It will be found that newspapers and other publications reach differing classes of prospects; therefore it is highly important that one give careful study to the publication in which his advertising is to be inserted for the occupation to be covered.

Schools, colleges, Y. M. C. A's., boy scouts, clergy, lawyers, policemen, and other agencies can be of great benefit in assisting you to secure the right sort of help. This assistance received from them will depend upon the reputation of your particular industry, and it behooves one to put his house in order before expecting any great amount of coöperation from his friends and neighbors.

In times when you are endeavoring to increase your force quickly, it is often helpful to ask persons engaged if they have friends who might wish to work on certain classes of operations, and if so, to send them to you. The results secured in this manner depend largely upon local conditions, but we have found it helpful and have often followed the plan of distributing small tickets with a number and the name of our employment office on them to workers, in order that they might hand them to friends who could present them at our employment office.

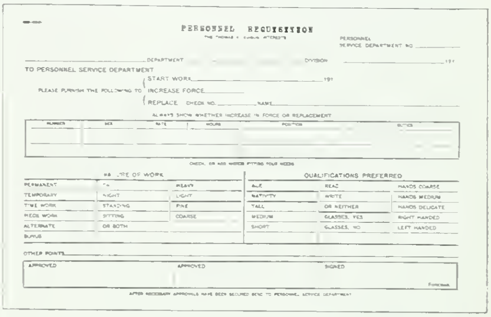
We have occasionally found it of value to go back over records of persons no longer in our service, and have them followed up to see if they might possibly be interested in coming back. This is more effective with highly skilled operatives than with others, but is simply one idea that has worked out in a satisfactory manner in our own experience.

Selection of Applicants

After the prospects have been developed, a process of selection becomes operative. This again is a matter of conditions, as with a large supply of labor more time and energy must be applied to sifting than in times when the demand exceeds the supply. If you have a large number to choose from you naturally exercise some choice, but where the number is small, you are required to accept the nearest approximation to the ideal. The employment office thus becomes a sifting agency in days of excess supply, and a collecting agency in days of excess demand. A centralized employment office reduces the expense connected with developing applicants, for if each individual function pursued its own way it might develop a prospect who would be of no particular use in that function and therefore be turned away. The prospect would thus be given no consideration in connection with vacancies in other departments, and the initial expense connected with developing prospects would be tremendous. A centralized agency has all of the demands of the organization before it, and if the prospect does not fit into one place there is a possibility of his being fitted in elsewhere. The initial expense is therefore reduced, and the reputation of the industry in the community is improved.

So far as workers are concerned, they naturally consider a group of industries operated under a similar name to be one firm. This is true, regardless of the fact that the industries may carry on widely different operations and the separate corporations be under entirely separate managements. In our case the Edison Storage Battery Company and the Edison Phonograph Works are two entirely separate corporations each with its own management. The workers, however, simply think of all our plants as "Edisons" and in judging "Edisons" think of it according to their experience in the department under the executive who represented "Edisons" to them. If, therefore, manufacturing units are grouped together in the eyes of workers, it is all the more important that standards for handling personnel be set up and that one policy prevail.

When a candidate for a position appears at the employment office, we seek to ascertain whether he has previously worked in any of the Edison Interests and, if not, secure his employment record in other industries. If on the basis of his previous employment record and questioning along the lines of the position open, he appears to be qualified, his record is written on proper forms by a clerk and he is sent to the individual making requisition, accompanied by a messenger. An introduction card accompanies him, and in case the executive interested accepts the candidate, he signs the introduction and returns it to the employment office by the messenger after inserting the date the individual starts work and the initial rate of pay. If the applicant is not satisfactory, the executive indicates the reason in the proper space on the introduction form and returns both applicant and form by messenger at once. Where the applicant is accepted, and that fact indicated on the introduction, the lower portion of the introduction form is detached in the employment office and goes to the proper accounting office as an indication of an authorized engagement. The time clock name number is given to the applicant at the employment office when he is engaged and a badge for identification is given at the employment office at start of the second day's work.



PERSONNEL REQUISITION

THE THOMAS A. EDISON INTERESTS

PERSONNEL SERVICE DEPARTMENT NO. ______

______ DEPARTMENT DIVISION ______ 191

TO PERSONNEL SERVICE DEPARTMENT

PLEASE FURNISH THE FOLLOWING TO
START WORK ______ 191
INCREASE FORCE ______
REPLACE CHECK NO. ______ NAME ______

ALWAYS SHOW WHETHER INCREASE IN FORCE OR REPLACEMENT

NUMBER	SEX	RATE	HOURS	POSITION	DUTIES

CHECK OR ADD WORDS FITTING YOUR NEEDS

NATURE OF WORK			QUALIFICATIONS PREFERRED		
PERMANENT	DAY	HEAVY	AGE	READ	HANDS COARSE
TEMPORARY	NIGHT	LIGHT	NATIVITY	WRITE	HANDS MEDIUM
TIME WORK	STANDING	FINE	TALL	OR NEITHER	HANDS DELICATE
PIECE WORK	SITTING	COARSE	MEDIUM	GLASSES, YES	RIGHT HANDED
ALTERNATE	OR BOTH		SHORT	GLASSES, NO	LEFT HANDED
BONUS					

OTHER POINTS ______

APPROVED APPROVED SIGNED

Foreman

AFTER NECESSARY APPROVALS HAVE BEEN SECURED SEND TO PERSONNEL SERVICE DEPARTMENT

CARD FOR RECORDING ENTRANCE INTO EDISON ORGANIZATION

Nature of the Examination

The nature of the examination at time of application depends upon the position open. When a stenographer or typist appears, we naturally give a proper examination for ability in the use of shorthand, also capacity for operation of a typewriter. We expect ultimately to have standard oral questions and in some cases limited written examinations for applicants. Such activities, however, only fit into the conditions of a market where supply exceeds the demand and the present time is not one in which any unusual expenditure of time or money for this purpose is warranted. The average industry now has little opportunity to select and must rather accept the nearest approximation to the ideal.

It is believed that methods of selection have hardly been explored as yet. There are great possibilities in this connection, and we expect some day to see rather elaborate organizations in industries for properly classifying men before they are actually assigned to a production position.

The addition of an individual to your organization or an "entrance," as it might properly be designated, starts a chain of records that are necessary if you expect to conduct your business on the basis of known facts. In our case an individual record is set up consisting of an 8 x 5-inch card and an 8 x 5-inch folder. The card contains the main facts, such as nativity, number of dependents, whom to notify in case of emergency, etc. It is filed according to name number, and name numbers are assigned according to departments. The first two figures in a name number generally link the individual with the department in which employed. The folder is filed alphabetically and provides an opportunity to retain various communications and other record information that may be secured in connection with the individual from time to time. The forms are so arranged that little, if any duplication of writing is necessary, and a four-way index is secured through their use. The first is according to name numbers; second, alphabetical; third, according to nationality, dependents, etc.; fourth, according to classes of positions. The last two indices are secured through the use of celluloid tabs affixed to cards and folders across the top on designations previously arranged for the purpose.

RECORDS AND STATISTICS

Statistics bearing on the occupations of applicants, their residence, so far as proximity to industry is concerned, number engaged for each department, number leaving each department, reasons for leaving, term of service of those leaving and similar points can be covered through the application of the proper method at the right point in the flow of vital information through the office.

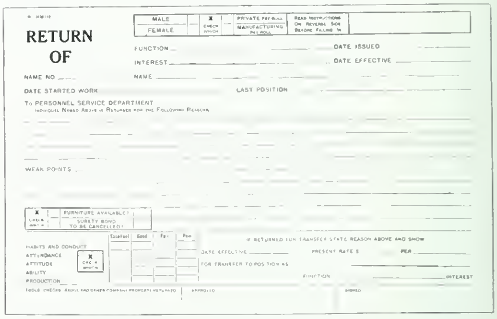
So far as addresses are concerned, it is known that changes occur frequently, and we endeavor to have a means of checking them up at any time. The pay coupon on the clock cards is used for that purpose, and it not only serves as a means of identification, but also as a receipt for the individual's pay for the period in question. At the same time it supplies us with his address. The filing of these pay receipts in the proper manner will make them available for address information at any time. Beyond this it serves also as an overtime pass.

In connection with the persons leaving, we follow the plan of having them "returned" to the employment office, no matter what the reason for leaving may be. In the Edison Interests the autocratic power to discharge is removed from any one person, and individuals can only be returned to the employment office where their cases are investigated. If the employment office agrees with the executive after an investigation, the usual process of removing the individual from the pay-roll is followed. If, however, investigation does not support the action of the executive, who might be the foreman, the matter is taken up with his division manager. If the division manager does not see fit to reverse the action of the foreman and the Employment Service Department still feels that justice has not been done, it may then appeal the case to the chairman of the executive committee, whose personal decision is final. The position of the employment office is that of the people's lawyer, as before stated, and while it is responsible for securing a square deal, it has no authority to enforce its beliefs. The result, however, is no less effective as the discussion necessary to clear up matters usually clarifies the situation and results in good feeling all the way around after a decision is reached.

Before we had developed our organization to the proper extent, we arranged transfers at the employment office in such manner that the foreman losing an individual or returning him for dismissal was not consulted. It was soon found that this caused the foreman to feel that he was not being supported, and it also gave the worker an opportunity to cause trouble by relating to his former companions how he had "put it over" on the foreman and gotten a fine job in another department. This naturally undermined the organization of the foreman and we sought to avoid it by consulting our foremen in every case before arranging transfers. They are usually willing to give men an opportunity in another department, and if so, we have them indicate it by signature on the back of the return form. This indication of willingness is then shown to the worker, who is informed that he is going on the other position because his former foreman has recommended the transfer. We have found that it results in a square deal from the standpoint of both worker and foreman, and creates a much better feeling.

KEEPING IN TOUCH WITH DEPARTMENT CONDITIONS

As previously stated, all men leaving for any reason are "returned" to the employment office and before their pay is given them they are expected to call at that office for an interview. By this means we keep in close touch with the conditions in every department, and are often enabled to straighten out misunderstandings that would otherwise cause us to lose a worker of several years' experience. It also keeps us closely in touch with working conditions generally throughout the community. The average worker feels that the employment office is more his friend than any other agency. It secured a position for him, had faith enough in him to recommend him for it, and has been interested in seeing that he was properly protected during the time he was in the position. He, therefore, is ready to take the employment office into his confidence where he would not do so with others, and we are thus enabled to be more closely in touch with activities throughout the organization. It furnishes a most excellent point of contact for the management in following out its policy of "one square deal."



RETURN OF

MALE		X CHECK WHICH		PRIVATE PAY ROLL	READ INSTRUCTIONS ON REVERSE SIDE BEFORE FILLING IN
FEMALE				MANUFACTURING PAY ROLL	

FUNCTION ____ DATE ISSUED ____
INTEREST ____ DATE EFFECTIVE ____
NAME NO ____ NAME ____
DATE STARTED WORK ____ LAST POSITION ____
TO PERSONNEL SERVICE DEPARTMENT
INDIVIDUAL NAMED ABOVE IS RETURNED FOR THE FOLLOWING REASON
WEAK POINTS ____

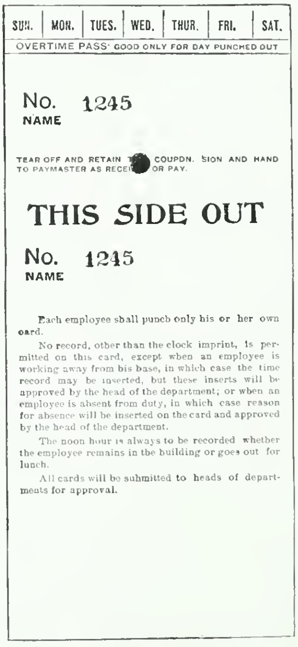
X CHECK WHICH		FURNITURE AVAILABLE?
		SURETY BOND TO BE CANCELLED?

	Excellent	Good	Fair	Poor
HABITS AND CONDUCT				
ATTENDANCE				
ATTITUDE				
ABILITY				
PRODUCTION				

X CHECK WHICH

IF RETURNED FOR TRANSFER STATE REASON ABOVE AND SHOW
DATE EFFECTIVE ____ PRESENT RATE $ ____ PER ____
FOR TRANSFER TO POSITION AS ____
FUNCTION ____ INTEREST ____
TOOLS, CHECKS, BADGE AND OTHER COMPANY PROPERTY RETURNED | APPROVED ____ SIGNED ____

RETURN CARD FOR PERSONS LEAVING EDISON INTERESTS



SUN.	MON.	TUES.	WED.	THUR.	FRI.	SAT.

OVERTIME PASS: GOOD ONLY FOR DAY PUNCHED OUT

No. 1245
NAME

TEAR OFF AND RETAIN T[illegible] COUPON. SIGN AND HAND TO PAYMASTER AS RECE[illegible] OR PAY.

THIS SIDE OUT

No. 1245
NAME

Each employee shall punch only his or her own card.

No record, other than the clock imprint, is permitted on this card, except when an employee is working away from his base, in which case the time record may be inserted, but these inserts will be approved by the head of the department; or when an employee is absent from duty, in which case reason for absence will be inserted on the card and approved by the head of the department.

The noon hour is always to be recorded whether the employee remains in the building or goes out for lunch.

All cards will be submitted to heads of departments for approval.

TIME CARD AND PAY COUPON

When workers report grievances to the employment office, they know that they are coming to an impartial agency. Most of them pertain to working conditions, but they touch all phases of the worker's life from home to health. All grievances are taken up with the proper executive and the employment office serves as the people's lawyer in securing a proper adjustment. It does not start out with the attitude that the foreman is wrong, that the worker is wrong, or that anybody is wrong, but assumes that all are right until an investigation proves otherwise. It often finds that the two parties who apparently are on opposite sides of a question are both right, and really not opposed. A slightly different method of presenting the subject may be followed and harmony restored.

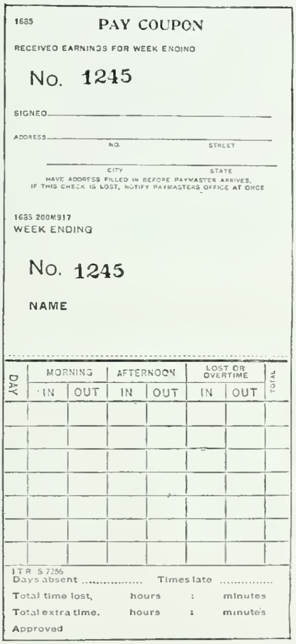
THE EDISON GUIDE BOOK

Workers when engaged are handed a copy of "The Edison Guide Book" which relates the general working regulations of the various industries, and points out that the facilities of the employment office are open to their use under certain conditions. We find that this is much appreciated, and a tremendous growth in the use of this impartial agency has recently been noted.

TRANSFERS

A centralized employment office affords numerous opportunities for transfers, and where men are engaged and do not fit the first position, we frequently transfer them to another and then to others until they seem to reach the right place. In case any department is required to reduce production and has a surplus of help, those individuals are returned to the employment office, and very frequently are placed in other branches of the Edison organization.

It is found that frequently workers become dissatisfied with their positions and apply at the employment office for transfers. In those cases we ask them to take the matter up with their foreman first, in order that he may be kept in touch with conditions in his department. If the cause is one that the foreman can correct, this results in a solution of the problem. If not, he is informed of the possibility of the particular individual leaving and generally consents to having the party transferred by indicating his consent upon the proper return blank.



1685 PAY COUPON

RECEIVED EARNINGS FOR WEEK ENDING

No. 1245

SIGNED

ADDRESS
NO. STREET
CITY STATE

HAVE ADDRESS FILLED IN BEFORE PAYMASTER ARRIVES.
IF THIS CHECK IS LOST, NOTIFY PAYMASTERS OFFICE AT ONCE

1685 200M917
WEEK ENDING

No. 1245

NAME

DAY	MORNING		AFTERNOON		LOST OR OVERTIME		TOTAL
	IN	OUT	IN	OUT	IN	OUT	

ITR S 7286
Days absent .... Times late ....
Total time lost, hours : minutes
Total extra time. hours : minutes
Approved

REVERSE OF CARD SHOWN ON PAGE 378

From the standpoint of forms, we consider a transfer to have two elements. One is the *engagement* in the department to which the individual is being transferred, and the other is the *return* from the department the individual is leaving. We, therefore, have no special form for effecting a transfer, but follow out the same methods to place the individual on the pay-roll in a new department and remove him from that of the old department, as in the case of an actual engagement from outside and removal. All notices for the addition of individuals to pay-rolls and the removal of persons from pay-rolls are issued at the employment office.

The issuance of passes, badges and tool checks at the employment office is an action that affords an excellent opportunity for checking the handling of company property and going the limit in avoiding loss on account of persons leaving. It practically focusses a statement of all property in the hands of each individual at the point where he enters the organization, and the last point of contact at the time when he is about to leave.

FORMS FOR THE VARIOUS EMPLOYMENT OPERATIONS

We have developed a number of forms for carrying on the various operations mentioned, and they are required to be much more elaborate in our case than might be necessary in industries differently organized. Our operations involve a great diversity of conditions. The hours differ in various divisions, the products are totally unrelated in many cases, we handle workers of all classes from chemists, draftsmen and executives to laborers and must, therefore, have a machine that quickly responds to pressure from a great many different angles. It has been our endeavor in developing forms to build them on the basis of the logical flow of information, and to visualize the act just as we might visualize the performance of an operation on a piece of steel in a producing department. The laying out of forms and their flow through the office is as much a matter of planning, scheduling, routing, etc., as the manufacture of storage batteries or phonographs in a manufacturing division.

So far as the result of setting up this centralized employment department is concerned, it is believed that the act has been more than justified. While the department does not claim credit for having accomplished it, the fact remains that after the employment and personnel department had been organized, the labor turnover of the Thomas A. Edison Interests was 50 per cent. less than previously. This was due to a large number of different conditions, yet we feel that the setting up of this centralized service agency played its part in bringing about such a highly satisfactory result.

Let Your Employees See Your Shop

By B. A. Wack

SOME time ago I happened to listen to the story of a clerk's successful career. Among some of the things he said were: "Several years ago when I first accepted a position my duties seemed to be so complicated and 'tasteless' that I had a notion to quit at the end of the first week.

At the end of the second week my situation was still undecided. A paralyzing hesitancy had occupied my mind and I experienced a difficulty in reaching a decision as to whether or not I should stay. A few days later something happened. My supervisor, guessing what was going on within me, asked me in a very agreeable way how I liked my work. Frankly, I replied, 'I am still looking for light on the subject.'

"My work consisted of estimating and describing machine parts. My employer escorted me down the shop, explained to me the how and why of everything. After he was through he advised me that I was excused from work for the rest of the day, that I could visit all the different departments and observe everything.

"The following day when I again started at work I found myself in quite a different disposition. My depressed feeling disappeared, things were clearer to me after looking at them with 'my own eyes.' The interest I took in my work progressed every day.

I feel convinced that this department visiting system would do its bit in a good many cases and I suggest to make it a company rule or practice.

Employers are anxious to get competent service, so why not use the best means for making help competent? Give your employees necessary information in the quickest and most practical way, and you will eliminate confusion and inconvenience.

Mastering Power Production--V

Importance of a Thorough Study of Processes and Operations

By Walter N. Polakov

In this installment the author takes up the work that must be done before operations can be standardized and tasks set—the latter are one of the cornerstones of his method of management. Involved in this work is securing the necessary knowledge, making this knowledge available and utilizing all the knowledge that is available. Tests made by untrained persons are condemned as a pure waste of time and money.

Mr. Walter N. Polakov *is a consulting engineer specializing in the management of power plants. He was educated in Russia and Germany, held a position of shop superintendent and chief engineer in Russia and was also instructor and consulting engineer to the Naval Academy at Baku. After coming to this country, and prior to taking up his own practice, he was consulting engineer to the Board of Estimate and Apportionment of New York City, then consulting engineer for the Penn Central Light & Power Company and later on, Superintendent of Power of the New York, New Haven and Hartford Railroad Company.*

ANY wilful act must have a preconceived aim. Until very recently business had as its sole aim *the securing of profit through marketing a commodity.* The satisfaction of the needs of the community, nation, humanity, was not the aim but merely the means whereby the profit could be obtained by supplying these necessities. Ergo, the cost of production was a matter of subordinate importance since the main issue was whether the difference between the cost of the product and its market price was big enough. Working along the line of the least resistance, more attention was paid to the increase of this difference by enhancing prices and stabilizing markets, than by a reduction of manufacturing expenses.

The war brought forward a new aspect: The supremacy of the needs of the community to those of an individual, and production for the common good became a keynote of the industrial readjustments. A task of such magnitude caused the shifting of the center of gravity in the problem of industrial management—that is, the reduction of industrial wastes became the predominating, supermost task. As long as this is done with corresponding decrease of production cost it is obviously to the mutual benefit of private enterprise and the country. Whenever it is not so, or the task appears to be a difficult or hazardous one, the state assumes the risk of operating the socially necessary industries.

With the present shortage of fuel and corresonding increase in the cost of power, with the existing possibility of curtailing production due to lack of fuel, not to mention the co-existing danger to the health and well being of the people, the problem of wise mastering of power production appears in all its gravity and assumes the importance of an international issue.

As I have tried to prove in the preceding installments of this series, it is not the excellence of equipment and supplies that determines the results, but the mode of their use. In other words, *the coördination of men's knowledge and efforts directed to the attainment of a well-defined high aim constitutes the task before the management* of the power industry to-day.

To accomplish the above task we evidently must have the plan, the aim and the mechanism whereby the aim can be attained by following the plan. Yet in putting this scheme into practice, these three elements become so closely interrelated that a superficial observer may fall into a trap and accept mechanism for the plan and its working for an aim. Obviously great confusion will arise in such a case when incidental and auxiliary is regarded as basic and essential. Such a "system" is bound to degenerate into tiresome and useless ballast. Thus tests, records, etc., while invaluable as means for discovery of truth and best ways of accomplishing certain work are useless if made out merely to fatten the files, and are decidedly harmful if carried out without clear understanding for what purpose they are ultimately to serve.

MANAGERIAL MECHANISM

With this word of warning, I will outline briefly the two sides of the managerial mechanism that prove successful in mastering power problems, namely:

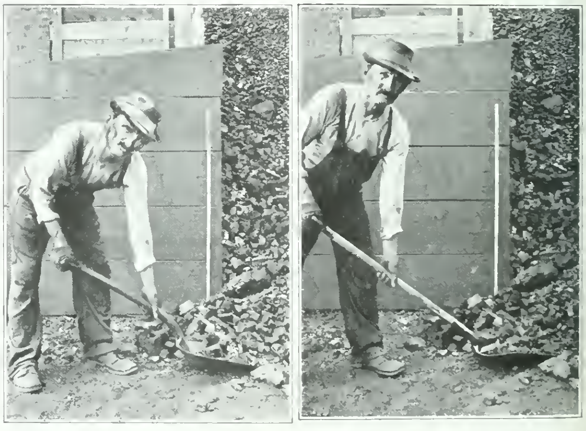
A. Securing results.
B. Observing results.

The process of securing results for the sake of systematic presentation should be further subdivided into three distinct steps:

1. Securing the necessary knowledge.
2. Making the knowledge available.
3. Utilizing the available knowledge.

SECURING THE KNOWLEDGE

Broadly speaking, there are two ways of acquiring



FIGS. 1 AND 2. IMPROPER IMPLEMENTS LARGELY CONTRIBUTE TO LABOR TROUBLES

Note the same man shoveling coal with the regular (too short) shovel and straining his back, and compare it with his position while using a correct shovel. Calculate out in foot-pounds and calories the energy wasted by a man through mismanagement

FIG. 3. MEN RESTING AFTER CLEANING FIRES

Thirty-two hundred pounds of clinkers were removed in 21 minutes without dropping steam pressure. What is the object of keeping men leaning against the wall?

knowledge. The first and most ancient method is based on *belief* in authority, either divine or human. It may be illustrated by the scholasticism of the middle ages and the method of teaching in our public schools. The second, as opposed to the first method, is based on the critical study of phenomena in accordance with the principles of scientific analysis. The entire progress of our life, applied and pure science, is based on the proper use of this method as a tool. Since modern or positive science, accepted as the criterion of truth is our ability to foretell the occurrences in time, space and effect, the difference between applied and pure science is merely whether or not we can influence the phenomenon at will. We can foretell the sun eclipse as precisely as turning out the electric light, but the latter we may cause at will by turning the switch.

Whereas the designers of power-plant equipment may justly be classed as engineers working on a scientific basis, inasmuch as the exact character of performance of this equipment is accurately predetermined by them before the drawings are sent to the shops, the same could be said of few managers of power plants. To predetermine accurately what result can actually be secured from the operation of a given plant appears to many as idle quest, or else they shrink before the task involving a mass of detail studies. Wherever these possibilities have been determined and causes producing the most favorable results clearly established, this knowledge has led to efforts to secure the results for which the plant was built.

The degree of engineering perfection of power plants is generally reckoned in terms of thermodynamic efficiency. This criterion alone is both inaccurate and insufficient. It is inaccurate inasmuch as the inherent thermodynamic efficiency of the plant, if determined either by calculation or by experiment under ideal conditions of a test, is not attainable in practise; if determined from everyday performance it is short by some unknown quantity depending chiefly upon the variable human element, mode of operation, etc. It is insufficient since the conception of thermodynamic efficiency does not include the "time element" which is the chief determining factor that must be considered in our industrial, commercial and social lives.

MAXIMUM THERMODYNAMIC EFFICIENCY NO CRITERION

Therefore, to accept a maximum thermodynamic efficiency of which the plant or each unit of a plant are capable as the task is of no avail:

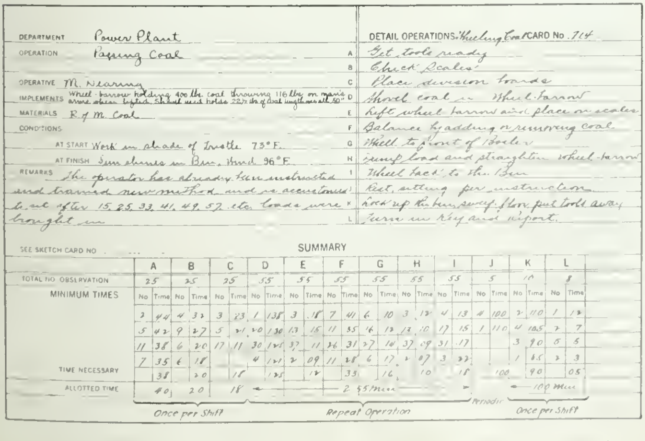
1. Because it is unattainable, and a certain gap between actual and ideal wipes out the dividing line between the best possible and the near-good results, the satisfaction of the accomplishment may come too soon leaving material losses unattended to, or the expectations may be placed so high that attainment is impossible under the existing circumstances which produces dissatisfaction and discourages further efforts.

2. Maximum thermodynamic efficiency is unfit to be a criterion of quality of operation because frequently the high thermal efficiency involves unwarranted expenses for its attainment or overtaxes the operators to an inadvisable degree.

For instance, it might be possible to secure in a boiler installation a thermal efficiency of 78 per cent. under ideal test conditions. Yet to maintain this every day may not be possible due to frequently and widely fluctuating load, or it would cost many times more to regulate the conditions than it would be feasible to save on coal. Again, we may find that allowing for the effect of all influential factors we can maintain 74 per cent. in everyday operation. In this case any task set below 74 per cent. would be a deliberate waste, and to set it above this mark would be a folly as it may be reached only under an accidental combination of favorable conditions to duplicate which is beyond the control of the operators.

From this standpoint all codes and rules for conducting boiler and engine trials are utterly unfit to guide the work of setting standards or tasks. The common shortcomings of all of them is that they deplorably ignore the main point—what tests are made for.

The work of testing boilers, etc., is not infrequently conducted by young college graduates, or sometimes by the boiler room force, even in the plants of reputable companies



DEPARTMENT Power Plant

OPERATION Passing Coal

OPERATIVE M. Nearing

IMPLEMENTS Wheel-barrow holding 400 lbs. coal throwing 116 lbs on man's arms when lifted. Shovel used holds 22½ lbs of coal length over all 50"

MATERIALS R of M. Coal

CONDITIONS

AT START Work in shade of trestle 73° F.

AT FINISH Sun shines in Bin. [illegible] 96° F.

REMARKS The operator has already been instructed and trained new method and is accustomed. Rest after 15, 25, 33, 41, 49, 57, etc. loads were brought in

DETAIL OPERATIONS: Wheeling Coal CARD No. 714

A Get tools ready
B Check Scales
C Place division boards
D Shovel coal in Wheel-barrow
E Lift wheel-barrow and place on scales
F Balance by adding or removing coal
G Wheel to front of Boiler
H Dump load and straighten wheel-barrow
I Wheel back to the Bin
J Rest, sitting per instruction
K Lock up the bin, sweep floor, put tools away
L Turn in Key and report.

SEE SKETCH CARD NO

SUMMARY

	A		B		C		D		E		F		G		H		I		J		K		L	
TOTAL NO. OBSERVATION	25		25		25		55		55		55		55		55		55		5		10		8	
MINIMUM TIMES	No	Time	No	Time	No	Time	No	Time	No	Time	No	Time	No	Time	No	Time	No	Time	No	Time	No	Time	No	Time
	2	44	4	32	3	23	1	138	3	.18	7	41	6	10	3	.12	4	13	4	100	2	110	1	12
	5	42	9	27	5	.21	20	130	13	15	11	35	16	12	13	.10	17	15	1	110	4	10.5	2	7
	11	38	6	20	17	.11	30	125	37	.11	26	31	27	14	37	.09	31	.17			3	9.0	5	5
	7	35	6	18			4	121	2	.09	11	28	6	17	2	.07	3	.22			1	6.5	2	3
TIME NECESSARY		38		20		18		125		12		33		16		10		15		100		9.0		05
ALLOTTED TIME		40		20		18	← 2.55 min →														← 100 min			
	Once per Shift						Repeat Operation												Periodic		Once per Shift			

FIG. 4. CONVENIENT FORM FOR TIME STUDY RECORD (FRONT, SUMMARY ONLY)

The data thus obtained are seldom reliable or complete and even if every factor, however insignificant, is measured and recorded, the results are of limited value except when such a test occasionally discloses a serious leak somewhere and the step may be taken to remedy the isolated cause of loss. To sum up the matter:

Inexpert Boiler Tests Wasteful and Misleading

A. The time spent and expenses incurred in conducting tests by untrained persons is a pure waste and sometimes harm is done by the wrong conclusions derived.

B. Tests that are made without keeping complete and continuous records of all conditions should not be run at all, as the results cannot be duplicated.

C. Tests that are not supplemented by time and motion studies on the men attending the units under test, are of questionable value inasmuch as the most important factor is thus overlooked: Whether under everyday service it is feasible for the men to duplicate the test conditions.

D. No test unless it is checked and verified by calculation is of any value; moreover, any test before it may be accepted as correct, should be checked several times by repeat-tests of long duration to ascertain that the results once obtained can be duplicated at will.

E. If the object of a test or time study is the discovery of the best method which is to be standardized, the work may be regarded as completed only when the findings are reduced to such plain written instructions that an average employee, after reasonable training and demonstration can duplicate the required results at will.

It is obvious that the task of securing complete and reliable information pertinent to equipment, supplies and men is the most exacting function of the management. It is more than testing any one process or performance, or time study of any operation. The influence of one or more variable conditions on the possible result is extremely intricate, but it appears still more complicated when one considers how many variable factors of both psychologic and physical nature must be accounted for in the case of a power plant.

Yet the difficulties are far from being insurmountable and the number of observations that may be sufficient are naturally limited by the limitation of the amplitude of changes within its minima and maxima.

Nevertheless, the nature of the work of obtaining necessary information, without which the management is but a haphazard undertaking and the results but a source of either pleasant or unpleasant surprise, is such that *this work cannot and must not be made a part of the duties of some power plant employee.* The nature of this research work requires quite definite qualifications of a man and anyone possessing them is too valuable to be engaged in any routine work. Again it is not within anyone's ability to do justice to both research and executive work.

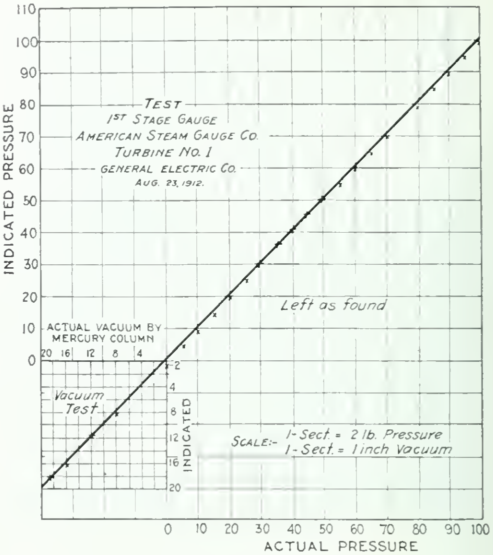


FIG. 5 RECORD OF A TEST OF A GAGE
No study should be made unless the accuracy of all instruments is verified before and after their use.

Power-Plant Research Man

A power-plant research man must be scientifically trained for vigorous, exact and minute observations.

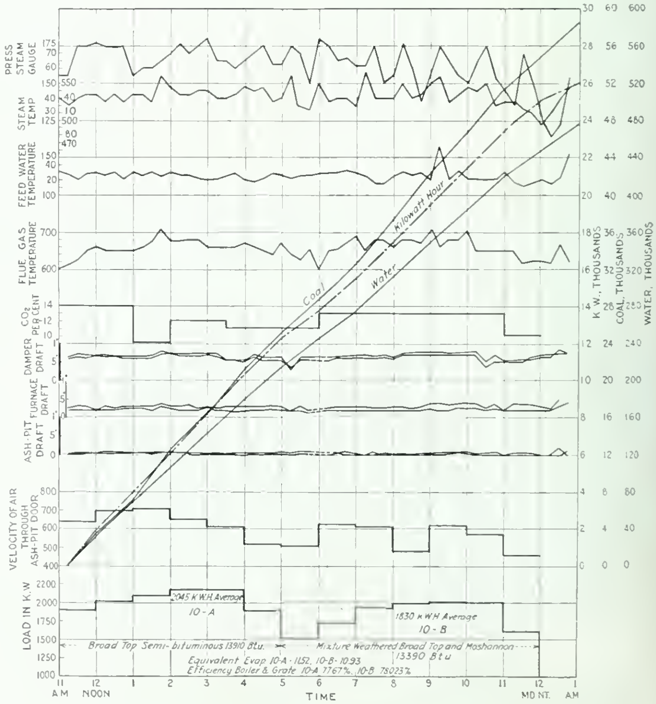


FIG. 6. RECORD OF THE TENTH REPETITION OF A STUDY TEST, ESTABLISHING, BEYOND DOUBT, THE POSSIBILITY OF A TASK FOR EVERYDAY ACCOMPLISHMENT

He must be able to concentrate his thoughts and attention on one specific subject at a time; he must have a broad vision and vivid imagination. He should be physicist, mathematician, economist, somewhat of a poet and largely a psychologist. To fill the bill is not an easy job, and our colleges are giving little help in this respect as their programs are calculated to give the students ready-made formulas and drill them in administering book-data rather than to cultivate in the young men the valuable faculty of *seeing things as they are and doing them as they should be done.*

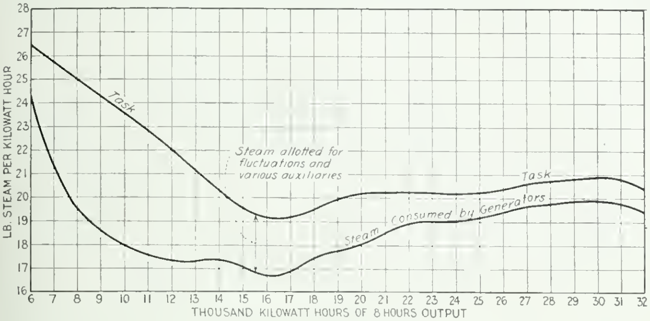


FIG. 7. GRAPHIC REPRESENTATION OF A TASK FOR SWITCHBOARD OPERATORS

Steam should be consumed in proportion with the load changing with the variations of output chiefly because of the dissimilarity of size and water rate of units installed in this plant.

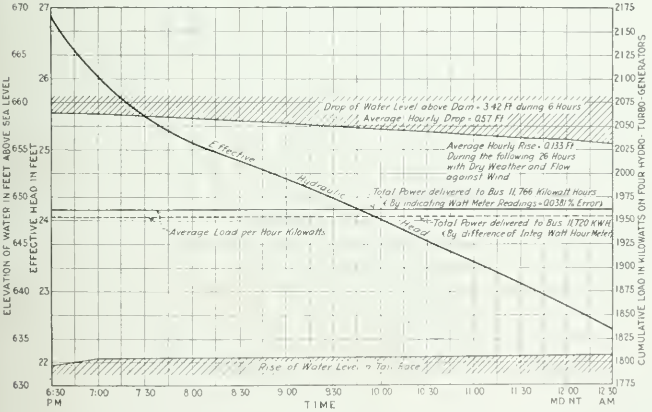


FIG. 8. LOG OF A TEST CONDUCTED TO DETERMINE THE EFFECT OF WATER LEVEL IN POND ABOVE THE DAM ON AVAILABLE HYDRO-ELECTRIC POWER, AND REDUCTION OF CAPACITY OF WATER WHEELS WITH REDUCED HEAD

Making Use of Knowledge

This prime function of management—securing accurate information based on facts and intended for use—is obviously a prerequisite to what may be called an executive function of making proper use of this knowledge. No amount of books and data secured elsewhere are of any use unless the effects of co-relation of all local factors are restudied under the existing circumstances and clearly defined. It would be obviously a folly to expect that two identical boiler installations in two different plants would be able to show identical efficiency unless load conditions, grade of fuel, quality of water, method of maintenance, practice of firing, hours of work, frame of mind of personnel and everything else were identical.

The object of these detailed studies of all power-plant processes and operations is in the final count, the discovery of the most satisfactory mode of operation. This does not mean, necessarily, the highest thermadynamic efficiency, as that may be incompatible with economy, safety or hygiene. Financial economy likewise may not be the object for the sake of which it would be wise to overwork men or to lose the good will of the employees and consumers. Again, a power plant, whether of a public utility or factory or in an isolated building or steamboat, is but a link in a great productive chain holding the economic structure of the country together, and this consideration cannot be lost sight of.

Thorough Knowledge Gives Basis for Standards

The first use of this thorough knowledge of *What* and *How* as obtained from the existing plant is the determination of standards for every performance and every operation. These standards should be modified by the above considerations and their relative relation on the ultimate result re-studied. When this is done, the second step is to determine a well defined task for every employee. This task idea received so much attention from other writers and is sufficiently well known to all progressive managers, that its psychologic effect need not again be discussed here. Yet the application of the task principle to power-plant work is not only comparatively new (the writer first applied it about 15 years ago on board ship), but somewhat different in its application to the power plants as compared with other industries. In the first place a task is a definite objective or aim. This definition often creates confusion, inasmuch as final results as to cost of power or efficiency of a process is taken for such an aim. This is true only insofar as it applies to those who have full control and responsibility of the final results. The firemen's or switchboard operator's task cannot be based on cost of steam, or k.w.h., or even efficiency because many factors influencing the final result are beyond the control of the fireman or operator. They do not buy coal, nor direct the maintenance work, nor specify the supplies, yet these factors plus the entire policy of the management may render their best and wisest efforts utterly unproductive of results. It is, therefore, necessary to establish definitely what are the conditions over which a man in a given position can exercise his control.

These conditions, once determined, are studied in relation to other interfering influences and their effect on some partial result is noted. If this work is done correctly it becomes obvious as to *What, When* and *How* anyone should *do*, and how his work contributes to the final success. The task of a fireman, therefore, becomes principally the adjustment of conditions of combustion, etc., in accordance with specific instructions stating what changes in the position of dampers, speed of fan, feed of fuel, etc., shall be made for every change of the rate of steam flow, etc. If supplies and upkeep are standardized and instructions made out correctly and scrupulously lived up to, there is little doubt but that the results will be gratifying, and may even fairly be measured in terms of thermal efficiency.

Similarly, a task for a switchboard attendant is specified as that of distributing total station load so-and-so among so many units. If the vacuum, quality of steam and other conditions beyond the attendant's control are as specified, we can measure his efficiency in terms of pounds of steam per k.w.h. output, though it is different for various rates and characteristics of the load. On the other hand, if the fireman adjusted his draft according to instructions but was misguided by a defective gage, or the switchboard attendant distributed load correctly but the vaccum and superheat were below standard, the first one could NOT be made responsible for poor evaporation or the second for the high-water rate obtained from the test.

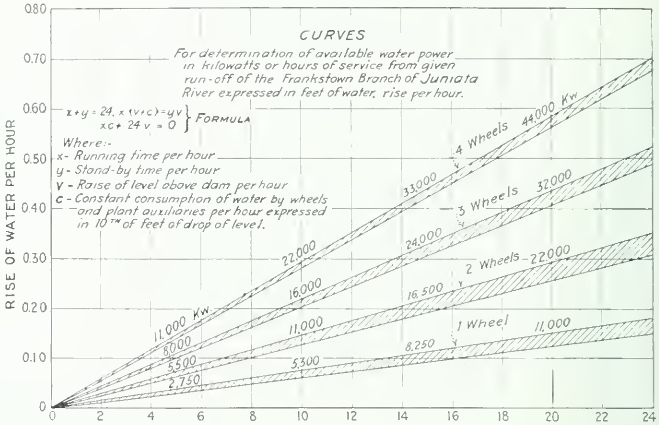


FIG. 9. RESULT OF TEST SIMILAR TO ONE SHOWN IN FIG. 8.

This makes possible a close predetermination of available water power for the next 24 hours after the rate of rise of pond level was observed during the night's shut down. Such knowledge is valuable for a combination steam and hydro-electric plant as it permits planning of the most economical distribution of steam load, higher steam economy and reduction of peaks.

RESULTS INDEPENDENT OF PHYSICAL EFFORT

In still another respect the power plant task is different; the quality of results is independent of physical efforts. With the exception of a small number of laborers engaged in cleaning and hauling all other classes of work are of such nature that no extra physical exertion could improve the economy or efficiency. In fact, almost generally the reverse is true. Firemen and coal-passers have less coal to handle with high evaporative efficiency than with a low one; cleaning fires and amount of ashes to be handled also often correspondingly decreases with the increased efficiency. On the other hand the higher degree of attention required to regulate properly the operating conditions is coincident with the loss of monotony, use of judgment, better physical comfort and infrequently reduced hours of work, which is equally true in regard to firemen, engineers, and switchboard operators. As to maintenance men and the repair gang, while the work is being done on schedule with carefully regulated inspection, the amount of rushed, hot and hazardous work under breakdown conditions is practically eliminated, and the running up-keep work is done under far more satisfactory conditions with proper tools and materials available, on units ready for work and cooled off; no two-man's job rushed unaided by one, etc.

The final peculiarity of task work in a power plant is that the volume of the output being independent of the employee, in a well organized plant no extra load requiring additional units in line necessitates more physical strain, as the dictates of high economy and efficiency demand that only a certain well defined number of furnaces or engines should be attended by one man.

While the research work leads thus to task setting and standardization of conditions it is obviously erroneous to assume that this function of management is purely a temporary one and once the work is done, tasks set and all details standardized, there is no more room for the research man. Outside conditions change constantly. The grade of fuel that was used is no more attainable or another source of delivery offered; a new grade of supplies is suggested; equipment is added or altered; men leave and new ones are hired; conditions of load change, etc.

Every change requires readjustments of methods which were correct under old conditions but may not be any longer with the change. Researches must be carried out constantly, and any change of condition, material, equipment and personnel must be immediately, preferably beforehand, called to the attention of the research man. Moreover, when work is being done on the basis of task-work-with-bonus every case of task not being lived up to must be immediately and impartially investigated, the cause of trouble found out and if independent from the man missing his task because of poor supply, planning, equipment, etc.), it must be remedied before the man returns to work next day. If it was, however, the fault of the man, the facts should be carefully ascertained, causes determined, and an instructor assigned to the man to help him out next time. A slight indisposition might be the cause of the man's lessening his attention, and good advice as to hygiene or dietetics may help. It may be a case requiring rest; it might be the beginning of a serious illness. None of these causes should be overlooked and it is the job of the research-man to study all such and similar everyday occurrences. Hence the work of research, investigating and study is not a temporary, initial one but is permanent and indispensable in any system of management that aims to master the production of power and not be a toy of accidents.

(To be continued)

ENGINEERING COUNCIL is compiling a calendar of conventions and other meetings of engineering and related societies. The purpose is to have this information collected in one place so that inquiries from societies, individuals or publications can be promptly answered and unnecessary conflicts of dates avoided. To assist in making this calendar complete and keeping it up to date, secretaries of engineering, public health and scientific organizations are requested to send to the Secretary of Engineering Council at 29 West 39th Street, New York, from time to time, information about the times and places of proposed conventions, annual meetings or other meetings of special importance.

The Problem of Women in War Industry

Will Women Be Needed in Industry? When Will They Be Needed?

By C. E. Knoeppel

How many of us have facts to support the view that thousands of women will be needed in industry before the war ends? Mr. Knoeppel *gives three great reasons: The present military situation; German strategy; the shipping situation. The conclusion cannot be dodged that millions of women must actively help in war pursuits. Before they begin this work millions of men now in trifling or non-essential industry must become soldiers, sailors or producers of war materials. But now is the time to plan the training and safeguarding of the women who will enter later.*

Mr. C. E. Knoeppel, *founder and president of the firm of C. E. Knoeppel and Company, consulting engineers, served through the shop as molder, draftsman and designer in the plants of several representative manufacturing firms. Later he became an expert systematizer. After specializing on analytical work in factory management he was in the employ of a number of industrial establishments, and was associated with three firms of industrial engineers. This experience led to the founding of the organization of consulting and management experts that he now heads and directs.*

THE first question to answer in considering this great subject of women in industry is whether or not we need women in large numbers. If not, any extended discussion of the subject is unnecessary. If we do, then the next question to decide is whether we need them now or will later on.

To answer the first question, three important and vital factors must be taken into consideration *most seriously*.

1. The present military situation.
2. German strategy.
3. The shipping situation.

The Present Military Situation

Germany, is addition to controlling the destinies of Austria-Hungary, Turkey and Bulgaria, is to all intents and purposes mistress of Serbia, Belgium, Poland, part of France, part of Italy, Roumania and Russia. The elimination of one enemy after another gives Germany access to rich deposits of minerals, oils, vast wheat fields, and the labor of conquered areas through deportations. She has several million prisoners of war who are trained men and 150 divisions of her own soldiers taken from the Eastern front; she can recruit troops from the captured Eastern sections estimated at from 500,000 to several million seasoned fighters, men who will be glad to fight for food and drink and money to send home. All of these forces she can concentrate on the Western front, Italian front, or both, sections which so far have been defended admirably by the Allies.

ESTIMATE OF MAN AND WOMAN POWER IN THE UNITED STATES

Available for war and war industry between the ages of 18 and 60		55.500,000
Soldiers and sailors	5,000,000	
Men and women needed in war industry (ratio 6½ to 1)	32,500,000	
Total needed for war		37,500,000
Available for regular pursuits		18,000,000

Can Germany break through, take Paris and then attack England? The foremost military expert in this country states that the result on the Western front is a military stalemate; that it had been demonstrated that no frontal attack by either side against the other can break through, nor can the long thin line be turned with Switzerland at one end and Holland at the other.

Suppose, however, that Holland or Switzerland or both, because of economic necessity or other reasons, are forced to join with the Central Powers? Is this an impossible outcome? Not if one interprets correctly, the statement recently made by Sir Auckland Geddes, Minister of National Service, in which he said that the disposition of the German Armies on the British front was most remarkable. He declared:

> They have placed mass upon mass and Germany's military object will be to strike at England. I have no doubt that Germany will strike not only at our forces in France but also, if she can, at the heart of England. Men in enormous numbers are needed, including men up to 50, to join for home defense.

Nor is he alone in this concern, as is evidenced by the statement of Major-General Sir C. F. N. Macready, Adjutant General of the British Army, who said:

> Every man that can be spared from the industries is badly needed. Every woman that comes forward helps her country by releasing a man. We appeal to them to answer the call.

Can Germany be beaten economically? Not according to Ex-Ambassador Gerard, who knows the situation from four years of first hand study, and who states:

> There is no chance of starving Germany and there is no chance of winning through a revolution in that country; Germany can feed all except her old people, whom she leaves to die; before they would starve themselves, they would starve 10,000,000 Poles, 5,000,000 Frenchmen, 2,000,000 Belgians and 2,000,000 prisoners of war; the only peace she would adhere to would be a peace that really gave her the Victory.

Mind you, he said this before the capitulation of Roumania and Russia, which places the Central Powers in a much stronger position than before.

As a result, the Kaiser now defiantly shouts, "we want peace and shall seek it but the victory of German arms must first be recognized."

Even if Germany gives up her captured territory, Pan-Germany will be an established fact (Germany, Austria-Hungary, Turkey and Bulgaria), with a population of 150,000,000, capable of maintaining an army of 30,000,000.

Truly not a pretty picture when we see after nearly four years of war, a successful conquest on the one side and a successful defense on the other. Let us inquire into these menacing conditions to ascertain the cause.

GERMAN STRATEGY

What is the reason for the above condition? Is it military preparedness? Yes, to some extent, but not altogether. Germany planned for a short war you will remember, but, as the saying is, "got left" and had to plan all over again and build a new machine.

The Allies for three years were in a much better position from the standpoint of materials, men, money, command of the sea and ships. Practically all the inventions now used in warfare, were of American, French or English origin. This country when a neutral was a gigantic storehouse for the Allies.

What accounts for the successful conquest of Serbia, Roumania, Russia and part of Italy while Germany was holding the Western front? German strategy, nothing more nor less, a fact admitted by Lloyd-George, who in a speech on November 12 last said that after three years of war the Entente had no plan of strategy.

I wish every one could read that admirable and illuminating article "Political Strategy" by Andre Cheredame in the March issue of *The Atlantic Monthly*. He says:

> As a matter of fact, this war not only is not solely a military and naval war, it is in addition, a geographical war, an ethnographical war, an economic war, a war of national psychology. To define its endlessly complex character by a brief phrase which includes all these factors, we may say that it is war of *political sciences*.

The conclusion and findings of this remarkable man, who has studied the terrible strength of Germany for 20 years, are nothing short of uncanny. He states that from the Battle of the Marne, down to the offensive against Italy, a period of 38 months, the whole strategy of Berlin, *based on a plan developed in 1895 or 23 years ago*, was as follows:

> 1. To organize an immovable offensive on the Western front, while pretending now and then to attempt a genuine attack.
>
> 2. To carry out without pause a series of circular offensives against Russia, Serbia and Roumania, in order to seize one after another, the territories of those states, which are essential to the constitution of Central Pan-Germany according to the plan of 1895.
>
> 3. To take advantage of these successive offensives on the Eastern fronts, to go to the very vitals of Germany's allies, properly so-called, that is to say, under cover of helping Austria-Hungary, Bulgaria and Turkey to defend themselves against Russia, Serbia, and Roumania, to organize those three countries militarily and economically and to the precise degree and in the precise form necessary to bring it about, that even at need, without changing their ancient names and the frontiers of 1914, they should contribute to practical purpose and almost without suspecting it, to the constitution of Central Pan-Germany.

The remarkable thing about it is that this man submits a copy of a map contained in a booklet published in 1895 entitled "Greater Germany and Central Europe about 1950."

The similarity between the map of 1895 and the performance of 1917 is sufficient evidence that there was more to it than just the military aspect. Plan and strategy are responsible. As Cheredame says:

> Thus on the Eastern front they have stopped on lines laid down beforehand, even when they had before them no Russian troops capable of opposing their further advance. Our map also enables us to declare on the most irrefutable testimony, that the offensive against Italy, which was such a surprise to the Allied staff was provided for most definitely in the plan of 1895.

This fact was recorded by Italian aviators November 22, and confirmed by German officer prisoners.

It is further shown that the Verdun offensive was really undertaken to offset allied plans for an offensive through the Balkans—the 1895 map line falls short of Verdun as it falls short of Venice; that Portugal is to be detached from the Entente; that Switzerland is to be violated, enabling Germany to seize Marseilles and Toulon, thus cutting France off from the Mediterranean; that Germany is to be left free to deal with Spain according to plans already laid down and outlined by Isaac F. Marcosson, in the *Saturday Evening Post*.

Hellish, isn't it?

THE SHIPPING SITUATION

So much for the present military situation and the reasons for it. I dwelt on both at considerable length to drive home the seriousness of the situation, to show that Germany, stronger than ever, will take a lot of smashing before she is defeated, to indicate that both time and intense effort must be expended before we will win this war.

If all the Allies were at maximum efficiency today it would still take a long time to defeat Germany decisively, for while she is hanging on to that Western front which experts tell us cannot be broken through, she is consolidating her gains in all captured territories, securing the benefits therefrom and using these resources against the Allies.

As the Allies are not at maximum efficiency, it will take a longer time, estimated as from three to seven years, and the reason the Allies are not at maximum efficiency is *SHIPS*.

The Germans are slowly clearing the seas of ships. For every ton of shipping built by the Allies and neutrals in 1917, the submarines sank 2.45 tons. During 1917, the submarines accounted for 6,623,623 tons. Great Britain and this country built 2,703,275 tons.

The sinkings, so far this year, according to Mr. P. W. Wilson, American correspondent of the *London Daily News*, are equivalent to three large ships daily, or 21 per week, of "over 1600 tons" as the British state it. The average citizen ignores the fact that the phrase "over 1600 tons" really means about 5000 tons, consequently the losses as indicated by February and March sinkings of this year are:

Weekly	105,000 tons.
Monthly	451,500 tons.
Yearly	5,418,000 tons.

Here, however, is the thing to think about. When the British talk of tonnage, they mean gross tons. When we speak of tons, we mean deadweight tons. In other words, a 5,000-ton ship as the British talk about it, is 7,500-ton ship as we express it. Our program was 6,000,000 tons for this year. Mr. Mark Sullivan of *Collier's* predicts that it will be 3,000,000 tons, or 2,000,000 tons as the British express sinkings. The President recently expressed his gratitude over the fact that we would produce between 3,000,000 and 4,000,000 tons. Call it 3,500,000 deadweight tons or 2,233,334 gross tons. If Great Britain turns out its normal tonnage (it produced 1,181,474 tons in 1917), there will be 3,514,808 gross tons between us. This means that during 1918, if the Germans keep up their present sinkings, *for each ton built 1.54 tons will be sunk, or 1.93 to 1 as the average for 1917-1918.*

Consider this also! It takes four to ten tons of shipping to transport and maintain one soldier abroad. The average is seven tons. To transport and maintain the army Senator McCumber stated we would need abroad —7,000,000 men—would require 49,000,000 tons of shipping. *All the Allied and neutral shipping afloat is 12,000,000 tons with the submarines slowly eating into this amount.* To even transport and maintain an army of 2,500,000 men—and we won't do our share with less —would call for 17,500,000 tons of shipping, or all that is available. *And shipping is being destroyed twice as fast as it is being built.*

If we cannot maintain a big army abroad through lack of ships, at the present rate of manufacture enormous quantities of aircraft, rifles, locomotives, trucks and automobiles will pile up in our ports, which will bring about industrial disorganization and compel us to stop making war products. *All of which shows that the key to our successfully waging of this war is ships.*

The neck of the bottle is ocean transportation, for we are producing war materials five times faster (*Collier's*) than we can transport them, and yet we merely talk of discontinuing non-essential industries.

We are going to get the ships, they will be built faster than they are sunk and when we have them we will put an army and supplies into Europe which with the Allies will put over the knockout. But not until every man and woman, every boy and girl, every grandma and grandpa, has done, not only his bit, but his utmost to win the war.

So you see that from the standpoint of the present military situation, the superior political strategy of the Germans and the lack of shipping, a long and bitter war is ahead of us, requiring millions of men in the field.

Let me give you an idea of the size of the direct and indirect army needed to wage this war victoriously!

We are told that the plan is ultimately to have 5,000,000 American soldiers abroad. It is estimated that it takes 6½ persons on farms, in mines, on railroads, in ships and in factories to maintain a soldier. This then means an army of 37,500,000 persons.

Statistics show that there are in the United States:

45,000,000 persons between the ages of 18 and 45
4,500,000 persons between the ages of 15 and 18
6,000,000 persons between the ages of 45 and 60

A total of 55,500,000 available for war and industry
37,500,000 needed in war pursuits.

leaving 18,000,000 available for regular activities.

As I see it, the above figures answer our question as to whether we will need women in industry or not. We will need them in increasing numbers before Berlin capitulates.

The war can only end in one of three ways

A. Lose.
B. Draw.
C. Win.

If we lose, the women need not concern themselves about going into industry—the *Germans will see to that.* If the result is a draw, we can prepare our boys and girls for the supreme struggle in about 25 years. If we win, it will be when 100,000,000 of us get behind the war as one man.

The President said to the farmers:

> The culminating crisis of the struggle has come, the achievements of this year on the one side or the other must determine the issue.

May the Almighty help us if this is so. May we awake to the seriousness of the thing and kill off forever this mad dog of Europe and destroy this poison which would set the world back 100 years.

There must be no draw. We cannot lose if posterity *means anything at all to us. WE MUST WIN.*

How long will it take? Colonel Sir Berkeley Moynihan, C.B., Senior Consulting Surgeon of the Royal Army Medical Corps of the British Army, said November 8, last before 1500 physicians and their wives at the Waldorf-Astoria in New York:

> I am asked how long the war will last I will say for America that the war will have just begun when every man of military age shall have offered his life to his country; when your wealth, your souls and your honor have been offered, when you have mourned your dead by the hundreds of thousands.

In other words, this war will be won when all have given their time, their money and if necessary their lives to the cause. Multiply all the latent ability and resources of each American by 100,000,000 and what will we have? The Kaiser in exile! If not he may decide to move his capital to Washington.

ARE WOMEN NEEDED IN INDUSTRY NOW?

We will need women in industry, of that there can be no question. Do we need them now? My study does not indicate this but it does indicate conclusively that later on we are going to need them in increasing numbers, and that now is the time to prepare and develop plans and policies, so that when we begin to utilize their abilities, we will be able to proceed along logical, fair and well determined lines.

The reason that we do not need women in industry now is simply because we are not using our man-power to the greatest extent possible, nor as efficiently as we can.

Let us discuss this question of man power for a moment. In our jails are men who could be put to work under guard either in industrial or agricultural pursuits. Elderly men who have retired, unless physically unable, could perform work of a light character in shops and offices. There is still in this country a greater degree of unemployment than is necessary and men who have nothing to do should be put to work. Tramps, street loafers and lounge lizards should be rounded up and put at productive occupations. Children from 12 to 16, both boys and girls, could be given something to do for part of their time each day. Workmen who take time off, because of high earnings, should be appealed to and kept busy even if we have to resort to penalizing them for failure to report for work. Shifting of workers can be eliminated by joint action by labor unions, manufacturers' associations and the government.

Men in clerical positions in office and shops, male waiters and elevator tenders in hotels and clubs, Pullman porters and conductors, taxi drivers and porters at the depots, and thousands of men in all walks of life whose work is not of a hard physical variety, could be utilized in the army, in shops and on farms.

We could take the cripples and the blind and teach them to be helpful. We have got to do it after the war—why not now? Also there are several millions of male and female enemy aliens who could be placed at some form of work under guard. We can also arrange for a carefully worked out and properly executed plan of labor dilution wherein a portion of the force in an efficient shop would be placed at the disposal of a less efficient plant. This by no means exhausts the list of places where men can be found, whose places or most of them, could be filled by women.

In short, my claim is that we should first use the women in the lighter occupations in order to utilize our man-power properly and avoid exploiting women, or putting them at industrial work before industry is ready for them, and my analysis indicates that industry is not ready for them as yet. By ready I mean providing safeguards, proper training, careful selection and the like. This leads me to the conclusion that we need a policy and plan of action, with the government behind the movement, and organized labor and the manufacturers of the country cooperating to the fullest extent.

Efficient Combustion of Bituminous Coal With Underfeed Stokers

By Russell C. Hine

A few practical points to be looked after in obtaining efficient combustion with underfeed stokers including: kind, quality and characteristics of the fuel; thickness of fuel bed, rate of feed; formation of clinker; draft; and furnace construction.

Mr. Russell C. Hine *has been connected with the engineering side of power production for the past three years. During that time he was engaged in testing and operating new installations of underfeed stokers for the Combustion Engineering Corporation and was in the mechanical testing department of the Midvale Steel & Ordnance Company. At present he is steam and combustion engineer for the Consolidated Gas, Electric Light and Power Co., in Baltimore, Maryland.*

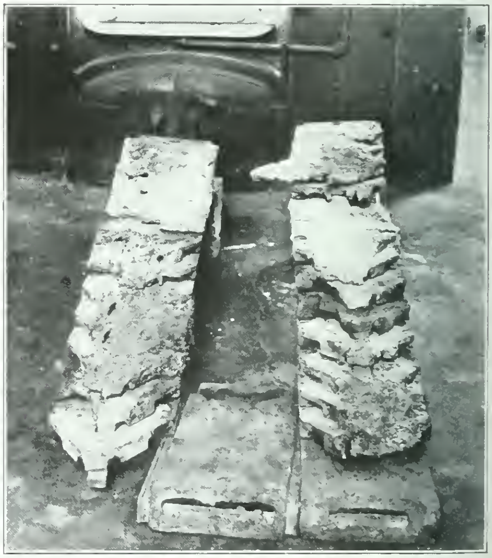
When estimating the national wealth of the United States the country recognizes coal as one of its most valuable resources. From the engineering and industrial standpoint it is of prime importance, for without this form of fuel practically no industry can be operated. For a long time people have realized the enormous consumption of this commodity and have recently felt the pinch of its scarcity. Due to the present international crisis, however, the acuteness of this situation is demanding the attention of everyone, and enormous expense has been incurred by the government to obtain expert advice on the analysis, price-fixing and establishment of the so-called "pools" for proper grading and distribution. The remainder of the burden rests with every consumer, to use carefully what is assigned to him by the administrators.

Furthermore, the general trend of the central station industry for the past few years has been toward a monopoly; this fact being indicated by the gradual retirement of the isolated station from the field of power generation. It is difficult, as a general rule, to obtain sufficient and necessary capital for the improvement of any industry whatsoever, if the rate of return is low. So earnings must be appreciable, or the cost of power generation must be maintained at a minimum, for rates are definitely fixed and controlled. Analyze the cost per kilowatt and it is found that the largest item appearing in it is the cost of steam generation, and of this 50 to 75 per cent. is a charge for fuel.

The logical deduction presented by such an analysis seems to be an introduction of some new method, or a change in method of operation, whereby the unnecessary use of coal may be reduced. Perhaps such a thing may not be required in those stations that are efficiently regulated. Extreme care exercised in the operation of fires may solve their problem to a considerable extent. Granting this possibility, some of the factors which affect the efficiency of combustion are here presented, but it should be understood that the formulation of any rules of procedure in combustion engineering presents a hard problem; every case differs from its predecessor in its circumstances and details.

Kind and Character of Fuel

The factor which deserves initial consideration is the kind and characteristics of the fuel which is used. Probably the easiest way to become acquainted with the differences between the numerous kinds of coal is to understand the various stages through which it passes during its formation, and the classification which results from its position in the transformation field.

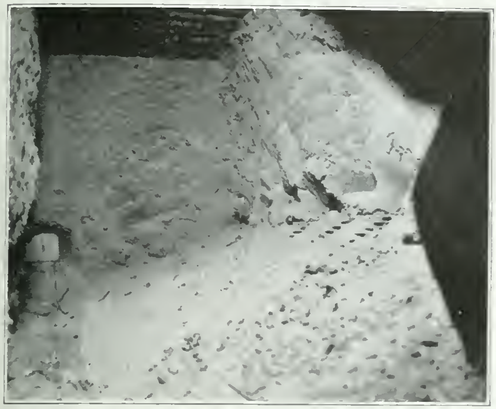


STACKS OF TUYERE PLATES BURNED FROM EFFECTS OF PLASTIC CLINKER FORMATION.

Recent scientific research proves the following fact. Coal is originally formed, with the assistance of pressure and heat, from organic compounds that are the principal chemical constituents of the structure of wood, leaves, mosses and the like. The Bureau of Mines has plotted the position of almost every coal mined in the United States, using the trilinear co-ordinates of carbon, hydrogen and oxygen. Inspection of this chart shows cellulose, wood, spores, mosses and so forth, at the extreme right, and pure carbon at the extreme left. The region between cellulose and carbon is occupied by the peats, lignites, bituminous and anthracite coals in the order given, showing a gradual transformation of one class to the other—until the anthracitization point is reached. At this point the coal line deviates somewhat sharply from the otherwise general direction. Broadly speaking, there is a loss of oxygen and gain in carbon content as the coal becomes aged. In other words, each class or kind of coal has an upper and lower carbon and oxygen ratio—the hydrogen varying within a small margin—and one kind of coal differs from another principally as a result of chemical changes due to age. The composition of the bituminous class, based upon this system of coordinates, varies between the following limits, and shows the reason why there may be so many different varieties.

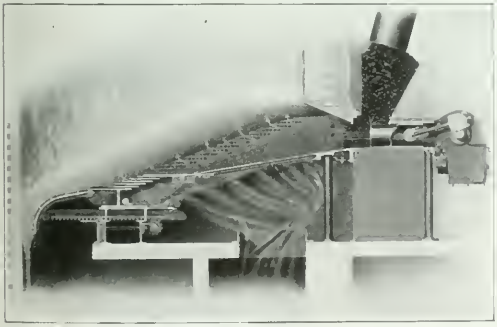
C, 75 to 92 per cent.
O, 21 to 2 per cent.
H, 4 to 6 per cent.

In all coals there is present a varying amount of volatile matter. This constituent is one of the most important factors to be considered, especially when burning bituminous coals. From the lower to the upper limit of the bituminous region, the percentage is abnormally high but diluted with non-combustible gases, rendering a low heat content per pound of volatile, approximately 5000 B.t.u. Such coals are usually rapid burning, high in ash content, and analyze with a low B.t.u. per pound on the dry basis. These coals closely resemble the lignites from which they are undoubtedly formed. Further transition not only decreases the percentage of volatile, but produces a change in its character for, in the better grades of bituminous coals, a concentration of resins and tars and increase of the richer hydrocarbons, produces an extremely complex nature of the volatile gases and a material increase in heat content.



COMBUSTION CHAMBER, SHOWING EXCESSIVE CLINKER FORMATION AFTER CONTINUOUS OPERATION AT 225 PER CENT. RATING.

Note formation on side and front wall, tending to advance into the fire.



SANFORD-RILEY STOKER, SHOWING PROPER, UNIFORM AIR DISTRIBUTION, A CONDITION WHICH MUST BE APPROACHED TO OBTAIN EFFICIENT RESULTS.

Note continuous ash discharge, eliminating loss of steam output, due to fact that no time is required to stop operation for dumping periods.

At this stage one recognizes the high steaming, caking and coking coals. Such changes in composition proceed to the point of anthracitization, previously mentioned, or the upper limit of the semi-bituminous region, after which the character of the volatile becomes much more simple, and finally assumes a state of almost pure methane gas. The heat content then reaches the value of 23600 B.t.u., which partly accounts for the high heat content of semi-bituminous and anthracite coals as compared with those always recognized as bituminous proper.

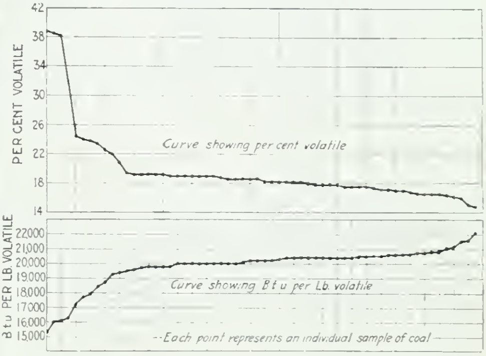


CHART SHOWING PERCENTAGE OF VOLATILE IN COAL.

SIGNIFICANCE FROM OPERATION STANDPOINT

Facts, such as these, have important significance from the operating standpoint. In general, as the amount of volatile increases, the overall efficiency decreases. Rapid distillation and heating occurring at high rating periods may result in incomplete combustion if the furnace chamber is not of ample size, or if the air is not properly regulated. The volatile must be uniformly distilled, supplied with the proper proportion of air, and the mixture ignited before it reaches the tubes. The greater the amount to handle, the more intricate is the problem, and the difficulty is increased if heavy hydrocarbons, tarry liquids and resinous compounds are present. This dictates the necessity of free and uniform air penetration, with the zone of combustion near the grate, obtainable only with thin, hot fuel beds, free from stratification and excessive caking action. Further consideration of the effects produced by the fuel upon combustion, brings one to the subject of ash content. A high percentage of this constituent is very undesirable, especially if it is composed of substances which flux easily or have a low fusion temperature.

Practically all coals clinker more or less, but the size and rate of formation increases with the rate of the firing. Thick fuel beds, moreover, show a great tendency to produce clinker, evidently due to inadequate air supply, which permits the ash to mix with partially burned fuel. The result is fusion due to the intense heat and the presence of fluxing agents. Some forms of clinker allow an escapement of air through them, causing a deficiency at other portions of the bed. Other forms, known as plastic clinkers, entirely block the supply of air by forming close to the grates or directly within the combustion zone of the fire. Excessive clinkering not only increases the loss of combustible in the refuse, but limits the combustion rate or the horse power that can be developed, and lengthens the cleaning period. Moreover, the heat value of any coal depends principally upon the amount and B.t.u. content of the volatile and fixed carbon. As the ash content increases, it reduces the percentage of one or both of these constituents, having itself no heat value whatever.

Effect of Sulphur

Lastly may be mentioned the effect of sulphur. Existing in a free state, it has a small heat value when burned, but the products are frequently corrosive in action. Other forms of occurrences are sulphates of calcium and sulphides of iron, or pyrites. This latter compound is the agent which assists and affects the formation of clinker, and particularly is this true if the thickness of the fuel bed is excessive.

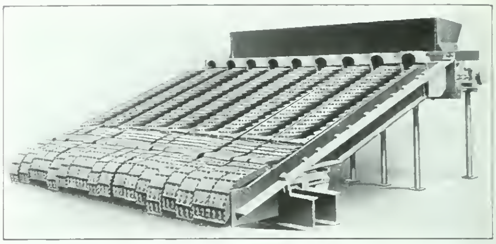
Therefore, the inherent and burning characteristics of the fuel suggest, in a measure, the method of operating the fires. The greatest part of the effects produced by such factors can only be determined by experience and trial. Many of these results are not controllable by the fireman, but there are a number of operating conditions which must be carefully adjusted and maintained by him under skillful superintendence if efficiency is to be increased.

Thickness of Fuel Bed

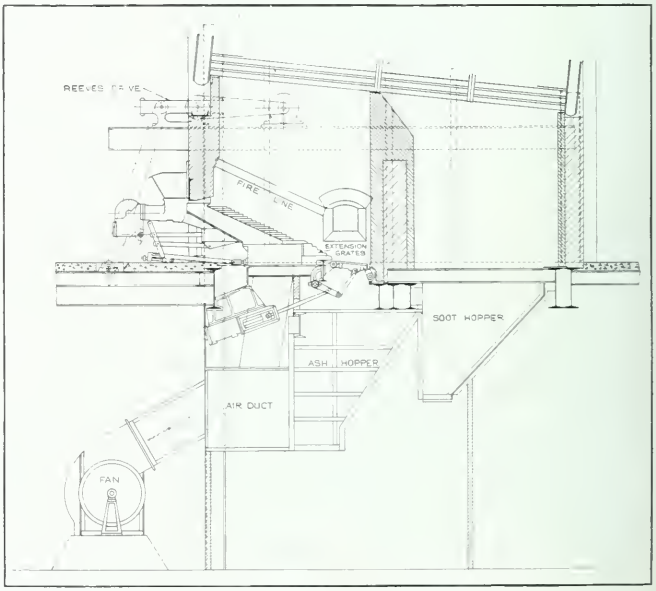
One of these controllable factors is the thickness of the fuel bed. The depth required for efficient combustion is a variable quantity, depending upon the kind of coal, the draft available, and indirectly upon the type of station load. Thin fires are always conducive to good results if the load is fairly light and the demand factor constant. They require, however, expert attention to prevent the formation of holes and admission of excess air, for if this condition results to any great extent, it is next to an impossibility to maintain uniform steam pressure. Should the type of load be the 24-hour variable load, it is found that heavier fires are better, as they are capable of the high heat evolution necessary for a sudden steam demand. However, if the bed becomes too thick for the tuyere pressure available, uniform combustion is impossible, as the air will pass out along the paths of least resistance. This condition is generally indicated by the alternate formation of "valleys" and spots of green fuel, known as stratification. The absence of proper combustion throughout the bed, and a non-uniform mixture of volatile and air, result in an incomplete combustion of the gases distilled from the fire, in addition to the fuel which remains. It is safe to say that heavy fires can be carried without much trouble, when free-burning, non-caking and low ash coals are used; provided, of course, that sufficient pressure is available from the fans, a most important detail.

Rate of Feed

Closely allied to the subject of bed thickness is the problem of the rate of feed. In the determination of the maximum rating which can be developed by the boiler each of these factors must be taken into consideration, for a variation of one produces a variation of the other. The feed should be so adjusted that the best thickness of fuel bed will be maintained. In other words, just enough coal should be introduced into the furnace to obtain the necessary combustion rate required for the horse power demanded of the boiler. A rate greater than this not only produces an increased bed thickness and its inherent difficulties, but increases the loss of combustible in the refuse and necessitates burning-down periods with a reduction of horse power output. This matter of satisfactory fuel control is best obtained when the stoker drive is independent of the fan drive, for only then is it possible to maintain the correct ratio of air supplied to coal supplied.



INSIDE VIEW OF SANFORD-RILEY UNDERFEED STOKER.
Note sliding retort sides continually agitating the fuel bed and eliminating poor air distribution due to clinker formation and excessive caking action.



MODERN INSTALLATION OF 11 RETORT TAYLOR UNDERFEED STOKER EQUIPPED WITH STEAM POWER DUMP, AND DRIVEN WITH THE REEVES VARIABLE SPEED TRANSMISSION.
Fan operates at constant speed, giving a method of obtaining any ratio of air to fuel. Each unit is equipped with a separate air duct and drive, giving a most flexible arrangement.

Formation of Clinker

Some of the difficulties presented by the formation of clinker have been mentioned in a previous paragraph, and it now remains to consider further the reasons for its proper removal. Any formation of clinker allowed to remain on the extension grates, not only retards the travel of the fire, but prohibits the proper function of the lower rams. As a result of this, partially burned fuel is forced over the clinker to the dump trays. This condition, together with inadequate air supply at this section of the fire, accounts for abnormal combustible losses in the refuse. A great deal of trouble has been experienced with formations on the side walls. These clinkers extend over the end air plates, creating a back blow of gas into the fireroom, or reflecting considerable heat on the grates which will eventually be the means of burning them. Since the air is usually forced through the adjacent tuyere, there is a general tendency to develop blow holes at this location, with the result that the fuel fed next to the wall fails to burn. Current practice suggests the installation of ventilated side walls, which may remedy the trouble by preventing fusion of the clinker to the firebrick.

Such is the nature of some of the factors deserving thought and attention if operation is to be improved. Engineers are beginning to realize the advantages of flexibility in furnace and boiler control, and a great deal has been accomplished. Beneficial results, however, can only be obtained by correlation of all the influential factors and this requires skillful engineering by the operating crews.

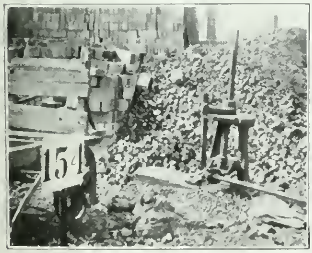
How to Prevent Freight Car Demurrage

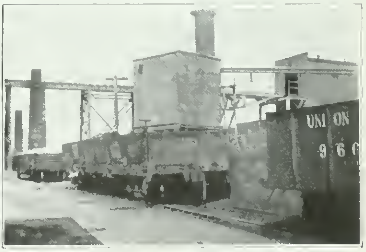
A Workable System By Which Loading and Unloading Time Can Be Cut to a Minimum

By Dwight T. Farnham

Many an industrial plant receiving and sending out a number of freight cars each day has faced a severe problem this past Winter in facilitating their movement. It has seemed that a combination of unaccommodating switch crews, shortage of labor and severe weather had conspired to make it difficult to load and unload cars rapidly. One plant solved the problem by planning the handling of cars and setting up standard practice instructions. Mr. Farnham *tells how it was done, gives the instructions in detail and shows the result.*

Mr. Dwight T. Farnham's *industrial experience covers some thirteen years in a number of plants as laborer, foreman, superintendent and manager. For the past four years he has been engaged in industrial engineering work; two years as supervising engineer for the* Emerson Company, *and two in private practice.*





IN the present crisis it is the patriotic duty of every man responsible for the administration of any business to assist the government to transport materials, food and man by doing everything in his power to facilitate the movement of freight cars. Incidentally, those in charge of the railroads have placed penalties upon the undue retention of rolling stock that make it very expensive to be unpatriotic.

To the small concern handling only ten or a dozen cars a day, patriotism in this respect is comparatively simple. The large plant, receiving 30 or 40 loads of material and supplies and 25 or 30 empties every day, may have the best intentions in the world and yet every month have a bill from the railroads for special and simple debits which makes the general manager feel like a candidate for membership on the German general staff. Although he argues that the orders he gave the plant were so simple, "Don't keep a single car in the yard a minute longer than is necessary." "Unload everything as soon as it arrives." "See that the switch crews place the cars where they can be loaded with the least possible delay," the demurrage mounts up. Factory executives, accused of negligence and even of insubordination take refuge in complaints against the switching crews, the labor shortage and the weather. Even if it is granted that these three elements have been particularly trying this winter, it is hard to convince a general manager, confronted with reports of cars held on factory sidings seven or eight and even ten and twelve days, that what has happened can be construed otherwise than as "acts giving comfort to the enemy."

The accompanying charts, Figures 1 and 2, tell the story of a fight which was nearly lost. The event is reminiscent of that description of the British "who always lose every battle except the last one," showing as it does the struggle against increasingly adverse conditions which were only conquered by the introduction of the definite methods of control described in the succeeding paragraphs. For instance, on Figure 1 it will be noted that the debits incurred whenever a car was left in the plant more than 48 hours during the nine months were never less than eighty. The system described was installed early in January and in spite of the fact that it was operative only for little more than half the month it resulted in the debits dropping to twenty-four. In February, when the system was working smoothly, only three debits were incurred—a reduction of 96 per cent. over the best month under the old system. On Figure 2, which illustrates conditions prevailing on the other railroads entering the plant, it will be observed that debits reached the vanishing point in February.

The Plant and Its Executives

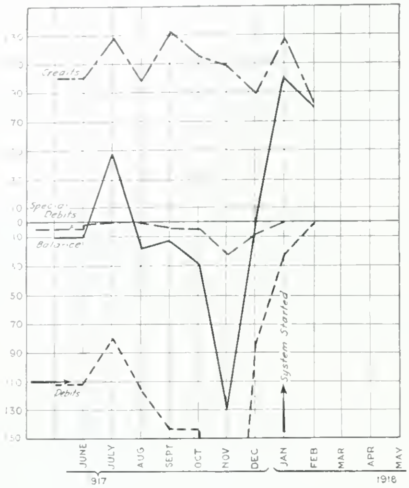


FIG. 1. CAR DEMURRAGE CHART.

The plant in question was a large one, covering perhaps ten acres, was located on two railroads and received a varied assortment of raw materials, fuels and general supplies. From 10 to 20 cars of finished product were shipped each day. Train crews in the employ of the two railroads did all the switching and were composed of men of good intelligence who usually endeavored to follow directions and to be accommodating. The shipping clerk and his assistant, the yard boss and, in fact, all the men who handled the detail of planning and supervising the placement of the cars, and who were responsible for loading and unloading, were men of unusual intelligence. The plant executives were exceedingly anxious to do everything possible to carry out the orders of the management who insisted—continually and relentlessly—upon cars being left in the yard the shortest possible length of time.

In spite of every effort made to carry out instructions the results were those shown on the charts. A system of planning the loading, installed the latter part of June, gave some relief in July, but by August the balance of credits over debits had fallen below the zero mark. Special debits representing cars retained five days over the 48 hours allowed, were incurred in September and increased until November when 22 were incurred on one road. During the same month 239 simple debits were incurred on one road and 50 on the other. The first month the system was in operation—for a part of the month only—special debits disappeared and simple debits decreased to 24 on one road and 6 on the other, in spite of the almost impossible weather and labor conditions existing in January. In February, under the same adverse conditions, debits were decreased to 3 on one road and to 0 on the other.

The detail of just how this was accomplished is explained fully in the standard practice instructions given. In explanation, it should be stated that the plant had been operated for more than a year under scientific efficiency methods and possessed a well developed planning department under a chief despatcher, a reservoir crew subject to supervision by the Employment Manager and various similar features peculiar to the most modern type of industrial organization. There is no reason, however, why any plant whose management is not satisfied with the monthly debit report should not adopt:

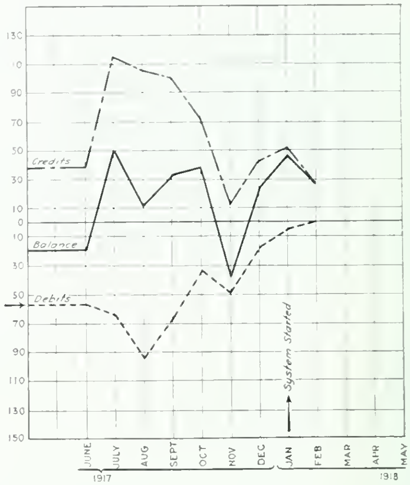
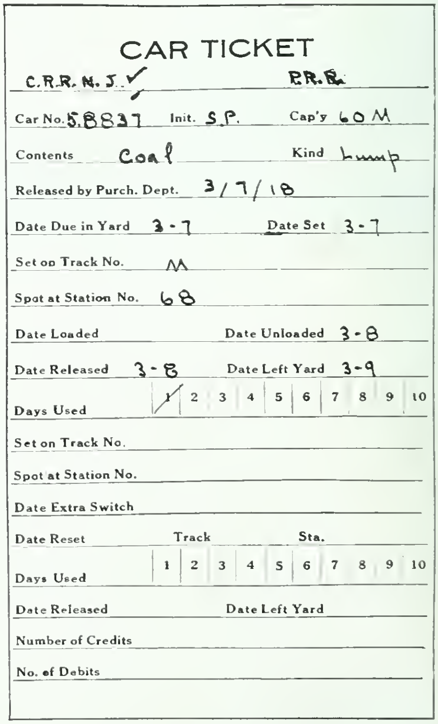


FIG. 2. CAR DEMURRAGE CHART.

1. *The car ticket,* which contains the complete history of each car set in the plant and is so arranged as to conserve clerical work by making it unnecessary to record the car number, etc. more than once.



CAR TICKET

C.R.R. N. J. ✓ P.R.R.

Car No. 58837 Init. S.P. Cap'y 60 M

Contents Coal Kind Lump

Released by Purch. Dept. 3/7/18

Date Due in Yard 3-7 Date Set 3-7

Set on Track No. M

Spot at Station No. 68

Date Loaded Date Unloaded 3-8

Date Released 3-8 Date Left Yard 3-9

Days Used ~~1~~ 2 3 4 5 6 7 8 9 10

Set on Track No.

Spot at Station No.

Date Extra Switch

Date Reset Track Sta.

Days Used 1 2 3 4 5 6 7 8 9 10

Date Released Date Left Yard

Number of Credits

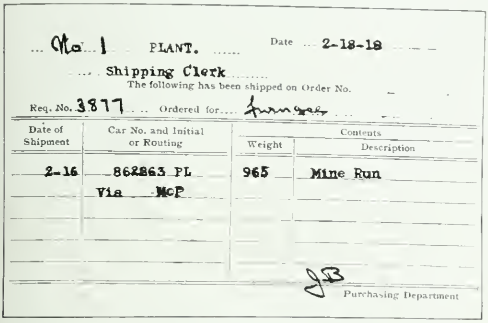
No. of Debits

FIG. 3. CAR TICKET ISSUED BY YARD BOSS.

2. *The priority sheet,* which brings home to those directly responsible for the loading and unloading—and

indirectly to the traffic, purchasing and sales departments—the exact and relative urgency of providing for the release of each car set.

3. *The switch list*, which furnishes the switching crew directions in writing as to just where each car should be placed, so fixing responsibility for error and neglect, by providing against orders impossible to fulfil and against misunderstandings of all sorts. When completed by the notation upon the back of any orders which could not be carried out, and the reasons therefor, the switch list furnishes a complete record by means of which the railroad's monthly bills for demurrage may be decided and complete evidence may be presented proving any necessity for changes in methods of freight handling.



No 1 PLANT. Date 2-18-18

Shipping Clerk

The following has been shipped on Order No.

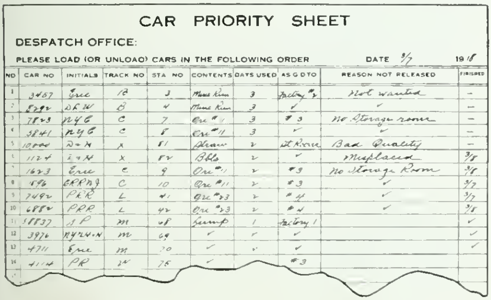
Req. No. 3877 Ordered for Furnace

Date of Shipment	Car No. and Initial or Routing	Contents	
		Weight	Description
2-16	862863 PL	965	Mine Run
	Via MoP		

JB

Purchasing Department

FIG. 4. RELEASE SHEET FOR CARS.



CAR PRIORITY SHEET

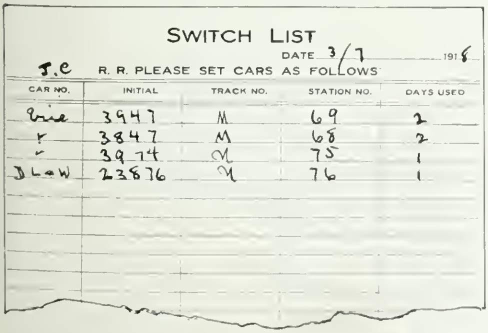
DESPATCH OFFICE:

PLEASE LOAD (OR UNLOAD) CARS IN THE FOLLOWING ORDER DATE 3/7 1918

NO	CAR NO	INITIALS	TRACK NO	STA NO	CONTENTS	DAYS USED	AS G D TO	REASON NOT RELEASED	FINISHED
1	3457	Erie	R	3	Mine Run	3	Factory #2	Not wanted	–
2	5292	DL&W	B	4	Mine Run	3	✓	✓	–
3	7823	NYC	C	7	Ore #11	3	#3	No Storage room	–
4	5841	NYC	C	8	Ore #11	3	✓	✓	–
5	10,000	D&H	X	81	Straw	2	St Room	Bad Quality	–
6	1124	D&H	X	82	Bbls	2	✓	Misplaced	3/8
7	1623	Erie	C	9	Ore #11	2	#3	No Storage Room	3/8
8	596	CRRNJ	C	10	Ore #11	2	#3	✓	3/7
9	7492	PRR	L	41	Ore #23	2	#4	✓	3/7
10	6882	PRR	L	42	Ore #23	2	#4	✓	3/8
11	58837	SP	M	68	Lump	1	Factory 1		✓
12	3976	NYO&W	M	69	✓	✓	✓		✓
13	4711	Erie	M	70	✓	✓	✓		✓
14	4114	PR	N	75	✓		#3		

FIG. 5. PRIORITY SHEET FOR CARS—MADE OUT IN TRIPLICATE

Standard Practice Instructions for Planning Car Handling



SWITCH LIST

DATE 3/7 1918

J.C R. R. PLEASE SET CARS AS FOLLOWS

CAR NO.	INITIAL	TRACK NO.	STATION NO.	DAYS USED
Erie	3947	M	69	2
"	3847	M	68	2
"	3974	N	75	1
DL&W	23876	N	76	1

FIG. 6. SWITCH LIST, MADE OUT IN TRIPLICATE

The nationalization of the railroads with increased demurrage charges on January 21, as well as motives of patriotism, make it imperative that no car be kept in the yard any longer than is absolutely necessary.

To secure this result certain fundamentals must be recognized:

1. To prevent cars being placed where they cannot be loaded or unloaded at all, or where loading or unloading is needlessly expensive, it is necessary to plan the placing before the cars come in. This is manifestly impossible unless information as to what is coming in is available.

2. To prevent misunderstandings with the switch crew, and to place responsibility in case directions are not followed, orders as to the placement of cars should be given only in writing.

3. When it is impossible to load or to unload all cars which are placed, the car which has been in the yard the longest should be taken care of first.

4. To prevent cars intended for other factories being unloaded by mistake, no cars should be unloaded unless due authorization has been received from the purchase department, which should do its best to order in such a way as to prevent the "bunching" of loads. The traffic department should assist in this in every way possible. As long notice as possible should be given the shipping clerk of the arrival of materials or supplies in carload lots, and the reservoir crew should receive this information early enough to enable it to plan its work effectively.

5. To facilitate procedure the following instructions have been worked out after consultation with the various executives involved:

(a) The yard boss—backed up and aided by the superintendent when it is necessary in order to secure results—will each morning as early as possible ascertain what cars may be expected from the Jersey Central. He will enter the car number, initial, capacity, contents, kind, and date due in the yard, of each car on a separate car ticket, Figure 3, and will hand these cards to the shipping clerk before 1 p. m. each day.

(b) The shipping clerk, or his assistant, will then note the fact on the car ticket, Figure 3, if the car, in case it is a load, has been released, Figure 4, by the purchase department. If it has not been released he will immediately phone the purchase department for release and write 'phone" in the space provided. All shipment notices should be filed by the shipping clerk, who should secure a written confirmation of all phoned releases.

(c) The shipping clerk will then note on the car ticket the track and station where the *empties* available for loading out should be placed. Meantime it is expected that the chief despatcher, having consulted with the assistant superintendent—and with the superintendent when necessary—will inform the shipping clerk what cars already in the yard are to be *replaced* and where, making use of the car ticket rack and priority sheet in so deciding. He will also inform the shipping clerk where all incoming *loads* are to be placed.

(d) Once a tentative decision is reached, the placement of the cars, both new and old loads and empties, so decided upon will be entered on the car tickets. The shipping clerk will also note the fact as to whether the car is fairly certain to be loaded (or unloaded) by the usual time the switch is made by the railroad crew.

(e) Having planned the placement, the priority of attention will be determined by sorting the car tickets according to the number of days the cars have been in the yard. The car numbers, location, contents, etc., are then entered on the priority sheet, Figure 5, the loads being grouped together according to the days the cars have been placed and the empties being similarly grouped. The priority sheet is made out in triplicate, one copy going to the yard boss, to show him what should be unloaded first, one to the assistant shipping clerk, who uses it in planning his loading, and one to the despatch office.

(f) The switch list, Figure 6, is then made out in triplicate, one copy for the switchman, one copy for the despatch office, and one copy for the assistant yard boss who superintends the placing of the cars. At that time he should note all cars not placed exactly as ordered on the back of his switch list, giving reasons, and should turn it in to the shipping clerk as soon as the switch is finished.

(g) In case of the P. R. R., which switches usually four times a week in the morning, information as to what is to be placed should be turned in by the yard boss on car tickets not later than 8:30 a. m. The despatcher and shipping clerk will prepare a switch list for the P. R. R. switch crew but an additional priority sheet need not be made out unless it seems desirable.

(h) The car ticket rack, which is used to facilitate sorting car tickets according to priority, etc., contains five compartments as follows:

1. Cars which have been placed one day at time of planning.
2. Cars which have been placed two days.
3. Cars which have been placed three days or more.
4. Cars outside the yard not yet placed at time of planning.
5. Cars which at time of planning may reasonably be expected to be released at next switch.

(i) After the switch has been made the yard boss, when he hands in his corrected switch list shall go through the car ticket rack and correct it, putting the cards for class 5 cars, which were not ready to go out when the switch was made, into class 3 compartment or wherever they belong, and sorting into class 1 the cars which were previously in class 4 but which have since been placed, making necessary changes on ticket.

(j) At the time he redistributes the car tickets in the rack he marks on each card the date the car was released and the day it left the yard, together with the number of debits and credits. The total number of debits and credits accruing each day shall be entered in a book and charted each day.

(k) The daily car report for the traffic department at the general office shall be made out each day by the shipping clerk as heretofore. The information will be taken from the car tickets.

(l) All car stations shall be plainly marked with black stencilled figures at least six inches high on a white ground, such figures being painted on buildings where possible and elsewhere on a strongly set but inexpensive sign post. The station numbers shall also be shown on the plant map. (See illustration on page 391.)

* * * *

If every manufacturer, every jobber and every producer of raw material will have a chart upon his office wall showing just how many debits are incurred daily, weekly and monthly, he will devise some simple system which will collect the *facts* to show him just who or what is responsible every time a car is held for more than twenty-four hours. Once the responsibility for inefficiency is placed, in most cases, inefficiency ceases to exist. In this case let every man in a position of authority remember that every time he keeps a car a day longer than is necessary he is robbing himself, or some other manufacturer of war material, of just so much transportation service, and that he is hampering the government and adding to the duration of the war.

The Machinery of Refrigeration

By Charles L. Hubbard

The application of refrigerating machinery is rapidly extending, and today it is not at all unusual to find such a plant in connection with the power house of an industrial establishment. This article takes up the elementary principles of refrigeration, offers suggestions for the selection of a system, and illustrates and describes the principal types of refrigerating machinery.

Mr. Charles L. Hubbard *has had an extensive experience in the design and installation of power-plant machinery and for the last ten years has been in private consulting practice in Boston. He is a frequent contributor to engineering journals on power plant and kindred topics, and the author of "Power, Heating and Ventilation," and other text books on thermodynamics.*

THE science of refrigeration is of comparatively recent date, the first developments of any importance having been made in 1834 when John Perkins, an Englishman, brought out an ether compression machine which embodied the principal parts contained in the refrigerating machine of today. Some little experimenting along this line had been done as early as 1755, but nothing of any real value had been accomplished.

The first ammonia compression machine, recognized as such, was invented by Carré about 1855, at which time the Perkins ether machine was perfected independently by Prof. Twining in America, and Harrison in Australia. Since then improvements have been continuous up to the present time.

Elementary Principles of Refrigeration

The principle made use of in mechanical refrigeration is extremely simple and may be described briefly in the following manner: When water is changed into steam a certain amount of heat, called the "latent heat of evaporation," disappears, being used in the work of tearing the molecules of water apart and expanding to a greater volume. This heat, for evaporation under atmospheric pressure, is 970.4 B.t.u. per pound of water. At one pound absolute pressure, and 101.8 deg F., temperature, it is 1034.6 B.t.u., and at 100 pounds absolute and 327.8 deg. F. it is 888 B.t.u.

If the steam is condensed by passing it into a coil surrounded by cool air or water the same amount of heat is given out again. The process of refrigeration is that of removing heat from the substance to be cooled. If the latent heat for evaporating water could be drawn from the substance to be cooled, and the steam condensed in a separate receptacle, we should have the process of refrigeration. Heat, however, can only pass from a higher temperature to a lower, so that the temperature of the substance to be cooled could never fall below 212 deg. if water evaporated at atmospheric pressure were the medium used for abstracting the heat. Any arrangement of this kind is evidently entirely impractical, but it so happens that there are fluids which boil at a much lower temperature than water; anhydrous ammonia, for example, has a boiling point of—28.5 deg. F. at atmospheric pressure. Hence, if this be allowed to vaporize in a coil or other chamber, at atmospheric pressure, its latent heat of evaporation will be drawn from the air or liquid surrounding the coil, and theoretically, heat will flow from the surrounding medium into the ammonia until the temperature of the former falls to 28.5 deg. F. below zero. Here we have conditions which are suitable for practical application and which are made use of in commercial refrigeration.

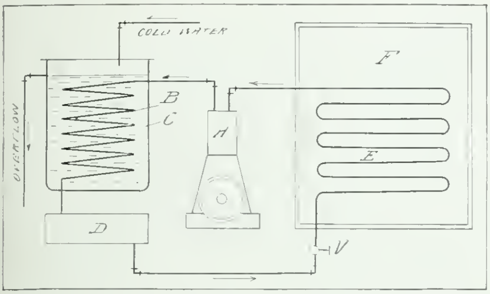


FIG. 1. DIAGRAM ILLUSTRATING PRINCIPLE OF COMPRESSION MACHINE WITH DIRECT EXPANSION

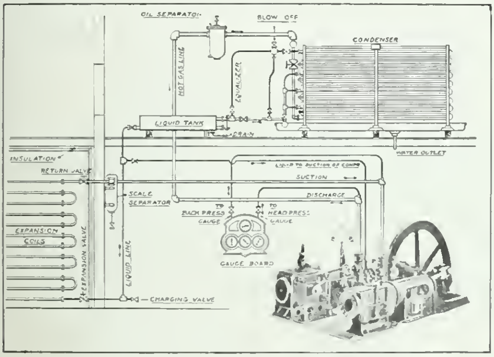


FIG. 2. DIAGRAM SHOWING THE WORKING PARTS OF A DIRECT EXPANSION COMPRESSION SYSTEM

Systems of Refrigeration

The two systems of refrigeration in common use are known as the "compression" and the "absorption" system, each having its advantages under special conditions.

Both of these systems make use of the elementary principle above described, but the methods of bringing this about are characteristic and radically different.

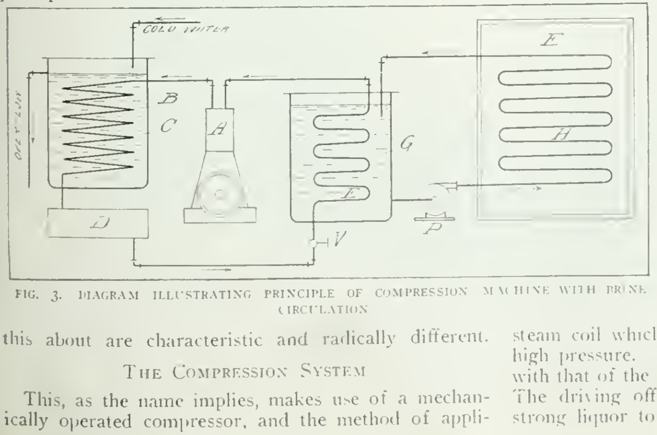


FIG. 3. DIAGRAM ILLUSTRATING PRINCIPLE OF COMPRESSION MACHINE WITH BRINE CIRCULATION

The Compression System

This, as the name implies, makes use of a mechanically operated compressor, and the method of application is illustrated diagrammatically in Figure 1. Referring to the cut, let *A* be a compressor of the piston type, *B* a coil submerged in a tank of running water, *C*; *D* is a receiver, and *E* a coil enclosed in a chamber or room *F*, which is to be cooled to a low temperature for storage purposes. In operation a certain amount of anhydrous ammonia or other working medium is placed in the receiver *D*, under pressure. The expansion valve *V* is opened slightly, and as the liquid ammonia enters the expansion coil *E*, which is under a lower pressure, it at once vaporizes, drawing its latent heat of vaporization from the surrounding air in the chamber *F* and thus lowering its temperature. The compressor being in action, gas from the coil *E* is drawn into the cylinder and compressed to a high pressure, then forced into the condensing coil *B*. This being submerged in cold water lowers the temperature of the gas, which under the combined effect of the high pressure and low temperature is condensed again to a liquid and flows into the receiver *D*, thus completing the cycle. A system of this kind in which the gas vaporizes in a coil located in the space to be cooled is called a "direct-expansion" system. A more accurate representation of the above, as applied to practical work, is shown in Figure 2 the condenser in this case being of the air-cooled type instead of submerged as will be described later.

In some cases it is more desirable to place the expansion coil in a tank of brine and pump the latter, when cold, through pipes located in the storage space. With this arrangement some of the work of refrigeration may be carried on while the compressor is shut down, which is often a matter of convenience in case of accident or minor repairs. This system is illustrated diagrammatically in Figure 3, in which letters *A* to *F* inclusive represent the same parts as before. In addition to these, *G* is the brine tank, *H* the cooling coil through which the brine circulates in the enclosed space *F*, and *P* the brine pump. A modification of the above, called the "congealing tank" system, is frequently used in small plants. This does away with the brine pump and cost of operation, also the insulation of the brine tank and piping.

In this system the brine tank is divided into a number of units, one being located in each compartment to be cooled, as indicated in the drawing. An expansion coil is placed in each congealing tank and the heat absorbing surface of the tank replaces the brine or direct expansion coil in the other systems described. In order to store more refrigeration in the comparatively small volume of the tanks a weak solution of brine is employed, which freezes and takes the place of the ice in the ordinary refrigerator.

The Absorption System

The absorption system is illustrated in diagram in Figure 4, and is identical with the compression system shown in Figure 1, except the compressor has been replaced by an "absorber," *J*, liquor pump, *K*, and "generator" *L*. In operation the gas from the expansion coil *E* enters the absorber *J* and is dissolved in water which is kept cold by means of a coil through which cooling water flows from an outside source. The solution of water and ammonia, called "strong liquor," is then pumped into the generator where it is heated by a steam coil which drives off the ammonia gas under a high pressure. From here on, the process is identical with that of the compression systems already described. The driving off of the ammonia vapor changes the strong liquor to "weak liquor," which, being under a higher pressure than the liquid in the absorber, readily flows back as indicated.

An elevation of a commercial absorption machine of standard make is shown in Figure 5 and illustrates various details and attachments not included in Figure 4 which is simplified to show the principle only. Referring to Figure 5, gas at low pressure from the expansion coil in the brine cooler is drawn into the absorber, and the strong liquor thus formed flows into the "aqua receiver" below. From here it is pumped through the "exchanger" to the generator, the former transferring some of the heat from the weak liquor to the cooler strong liquor. Separation of the gas from the water takes place in the generator and the former passes into the "rectifier" which removes any moisture which it may contain and discharges the dry gas into the condenser, from which it flows in the form of a liquid to the "anhydrous receiver," and thence through the expansion valve to the expansion coil in the brine cooler. As the pressure in the generator is higher than in the absorber, the weak liquor is forced out, passing through the exchanger and "cooler" on its way to the absorber.

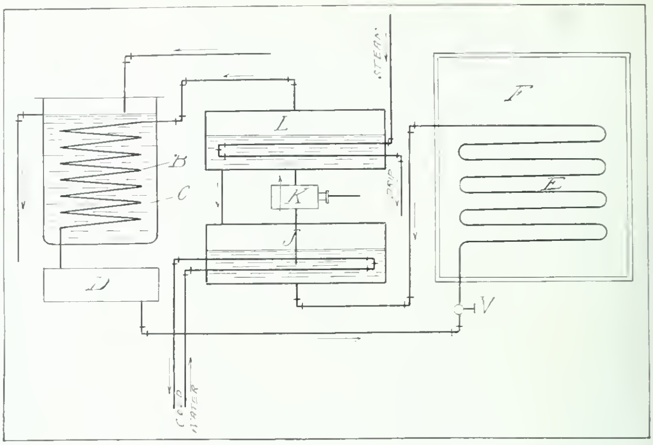


FIG. 4. DIAGRAM TO ILLUSTRATE THE PRINCIPLE OF THE ABSORPTION SYSTEM

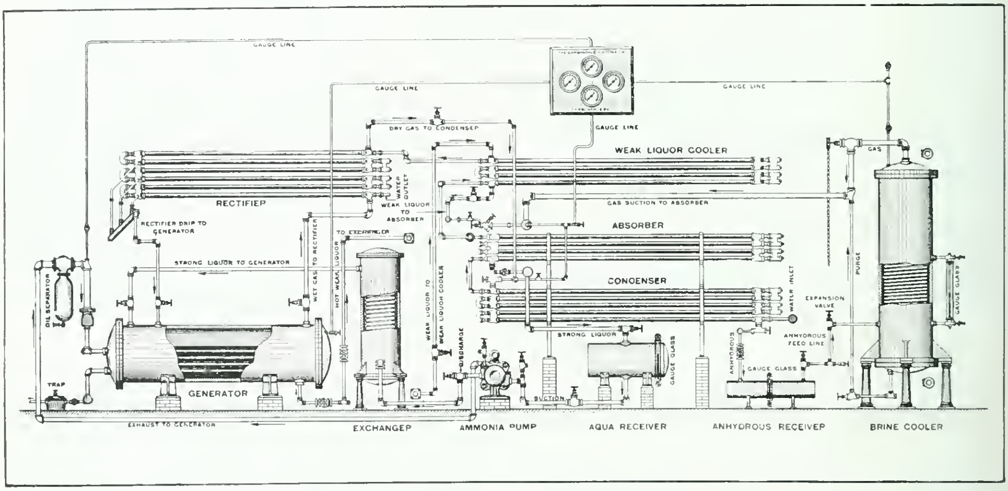


FIG. 5. SHOWING THE IMPORTANT WORKING PARTS OF THE CARBONDALE DOUBLE-PIPE ABSORPTION MACHINE

A machine of this type will operate with exhaust steam taken from a general heating system under a slight back pressure, and plants are also operating successfully in connection with the Webster and Paul systems of heating. The only power required for an absorption machine of this form is that necessary to operate the ammonia, brine, and water pumps, which seldom exceeds one-third horsepower per ton of refrigeration.

Working Medium

While many volatile fluids are theoretically adaptable as refrigerating agents, those which have proved most practical are anhydrous ammonia and carbonic anhydride. Although the same principle underlies the use of all such fluids, their physical properties vary and demand different treatment to secure the best results.

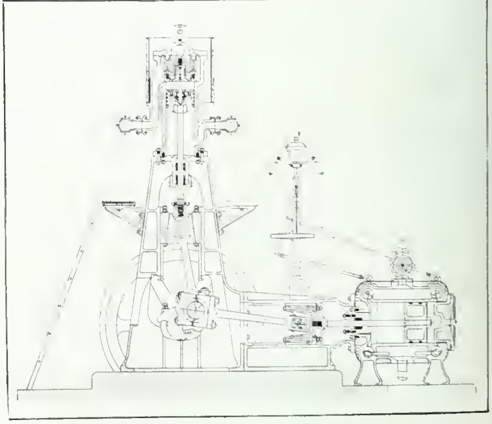


FIG. 6. VERTICAL SINGLE ACTING REFRIGERATING MACHINE

The ordinary working pressures of the ammonia systems are from 10 or 15 pounds on the evaporating side to 220 pounds or more on the condensing side, depending upon the requirements.

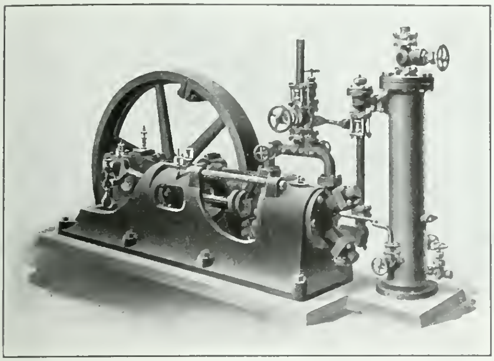


FIG. 7. HORIZONTAL DOUBLE-ACTING WOLFE LINDE MACHINE

Carbonic anhydride, or carbonic acid gas, is the same gas that is used for carbonating mineral waters and tonics and is put on the market in steel drums. It is produced in the process of fermentation and is a by-product of breweries. Its method of use is practically the same as with ammonia, although much higher pressures are employed.

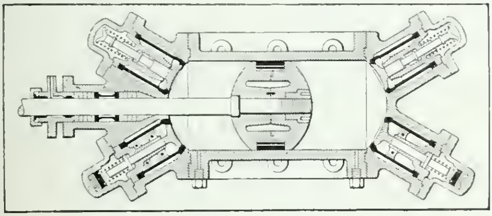


FIG. 8. SECTION THROUGH COMPRESSOR CYLINDER SHOWING CONSTRUCTION OF VALVES AND PISTON

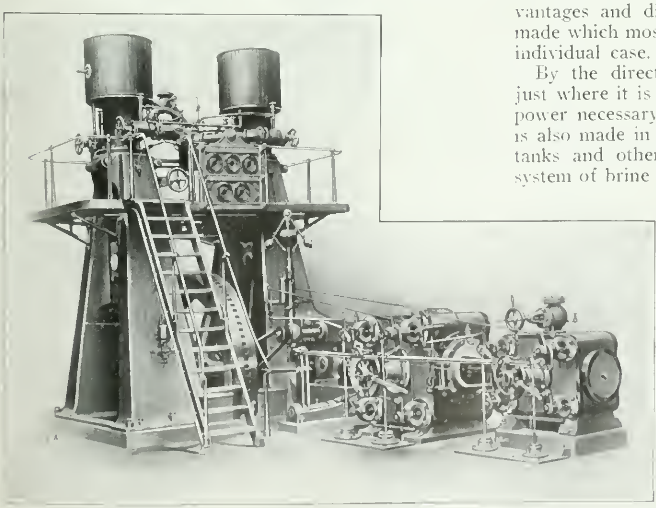


FIG. 9. FRICK COMPANY DUPLEX COMPRESSOR DRIVEN BY COMPOUND CORLISS ENGINE

Selection of a System

In making a selection between the compression and absorption systems one must be governed by local conditions, such as cost of installation and operation, whether exhaust steam is available as a by-product, size and use of plant, temperature required, etc. It may be definitely stated, however, that while the absorption and compression systems have both been employed in connection with the direct expansion and brine systems, the former is used more frequently for extremely low temperatures and the latter for medium temperatures. Both systems are employed in cold-storage warehouses, sometimes one to the exclusion of the other and sometimes in connection, the absorption machine being used for that part of the work requiring the lower temperature.

In freezing fish both types are successfully employed. In abattoirs, general practice makes use of the compression machine, also in breweries where the required temperatures are comparatively high. For hotels and restaurants, on shipboard, etc., both types are extensively installed.

The absorption machine is generally considered to be more economical than the compression machine when producing extremely low temperatures, under which condition, because of the lightness of the gas under the correspondingly low pressures, the compression machine loses greatly both in efficiency and capacity.

When exhaust steam is available as a by-product, the absorption machine has the advantage, as the compressor outfit is eliminated, thus simplifying the machinery of the plant as well as reducing the cost of power. On the other hand, the compressor plant may be operated by internal combustion engines or electric motors, thus doing away with the necessity of steam, which may be an important factor in deciding upon the type of system to be employed in any particular case.

Distributing Systems

Mention has already been made of the direct-expansion, brine-circulating, and congealing-tank systems for the distribution of refrigeration. Here, as in case of most mechanical equipment, each system has its advantages and disadvantages, and a selection must be made which most nearly fulfills the requirements of the individual case.

By the direct-expansion method, cold is produced just where it is required, and aside from the saving in power necessary to operate the brine pumps, a saving is also made in the cost of room, foundations, pumps, tanks and other equipment which is required for a system of brine circulation. On the other hand, direct-expansion causes frosting of the pipes due to their extremely low temperature and moisture in the surrounding air. This not only reduces the transmission and thus lessens the cooling effect in the room, but also cuts down the vaporization of ammonia gas and may cause the excess of liquid ammonia to flood over into the compressor or absorber. This difficulty is avoided in the brine system because the expansion coil is submerged and frost cannot collect. A practically constant back pressure on the system may be maintained by regulating the flow of brine into the cooling coils. With brine there is no danger of the ammonia fumes reaching the cold storage space due to leaks in the piping. However, the objectionable features of both systems may be reduced to a minimum by proper design.

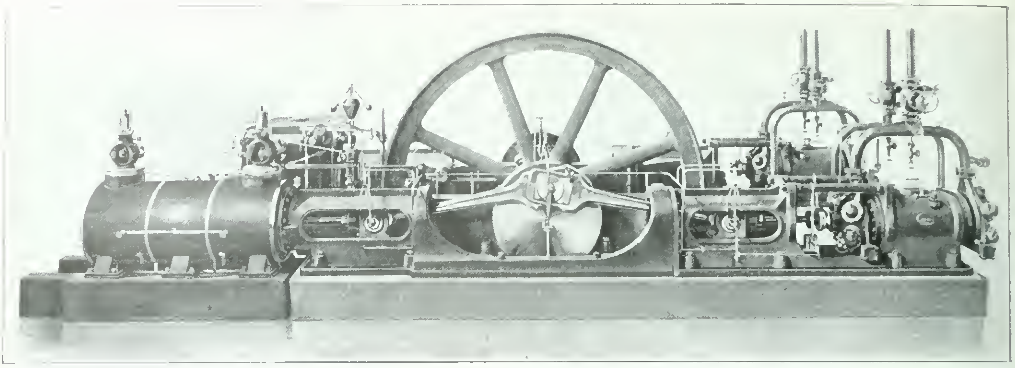


FIG. 10. VILTER DUPLEX DOUBLE-ACTING COMPRESSOR WITH CROSS-COMPOUND CONDENSING ENGINE

The congealing tank system is more especially adapted to small plants like refrigerators and cold storage room in markets, restaurants, hotels, dwellings, etc., as splitting the brine tank up into small units would tend to complicate a large system. As the weak solution of brine in the congealing tanks is frozen into ice, sufficient refrigeration is stored to last for a considerable period when the mechanical part of the plant is not in operation, a fact which particularly adapts it to the various uses above mentioned.

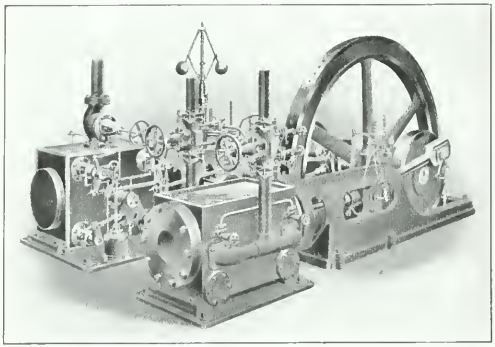


FIG. 11. DE LA VERGNE HORIZONTAL DOUBLE-ACTING COMPRESSOR WITH CORLISS ENGINE

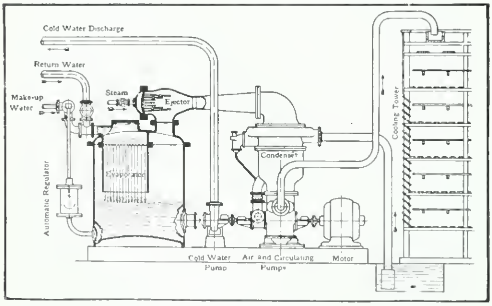


FIG. 12. TYPICAL ARRANGEMENT OF LEBLANC REFRIGERATING MACHINE

Power Requirements for Refrigeration

To melt one pound of ice at 32 deg. F., into water at the same temperature, requires 144 B.t.u., which is called the "latent heat of fusion." The "unit of refrigeration" is taken as the amount of heat absorbed by the melting of 2,000 pounds, or one ton of ice, and is equal to 2,000 × 144 = 288,000 B.t.u. When the capacity of a refrigerating plant is expressed in tons of refrigeration it is understood to mean tons in 24 hours, and when so used becomes a *rate* of refrigeration. In the case of a compression machine, working under average conditions, one indicated horsepower at the steam cylinder will produce about 60 pounds of ice-melting effect per hour or, 0.75 ton per 24 hours. This will, of course, vary somewhat with the range of pressure and also with the size and type of machine. Another method in common use is to provide 1.5 indicated horsepower per ton of refrigeration, which is slightly more than the above, the average of the two being about 1.4. If the machine is motor-driven, the efficiency of the engine, generator, and motor must be taken into account, which gives approximately $\frac{1.2}{0.7} = 1.8$ indicated horsepower per ton of refrigeration at the generator engine.

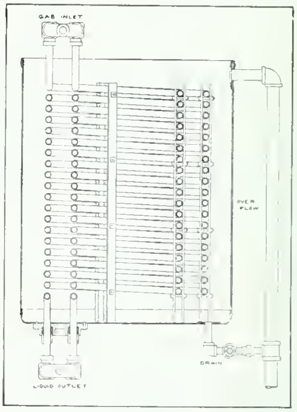


FIG. 13. SUBMERGED CONDENSER

Types of Compressors

Space permits but a brief mention of the details of equipment which go to make up the commercial plant. The machines illustrated in the present case will be those of representative type commonly used in plants of medium and large size. Smaller machines, and those of a portable or semi-portable type will be taken up in a following article devoted especially to the requirements of military camps and marine work.

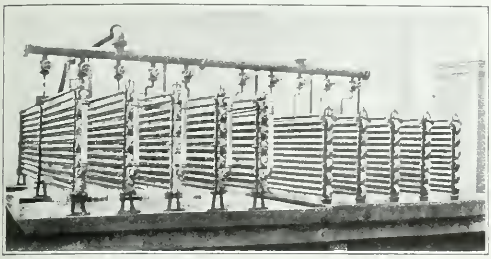


FIG. 14. ATMOSPHERIC CONDENSER

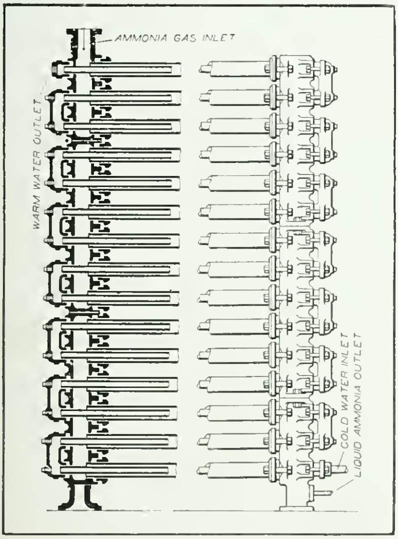


FIG. 15. DOUBLE TUBE CONDENSER

Ammonia compressors are divided into two general classes, double-acting and single-acting. The first of these is made both vertical and horizontal although more frequently in the latter form. A typical single-acting machine of the vertical type is shown in Figure 6, and illustrates the relative arrangement of compressor and engine cylinders as well as the principal details of design. Vertical compressors require less floor space than the horizontal type but are less accessible in case of repairs. This form of machine is usually provided with a "safety-head" which is ordinarily held to its seat by strong coil springs as indicated in the illustration. In case an abnormal amount of liquid, or any foreign substance, enters the cylinder above the piston, the springs are pushed back and the head released without injuring the machine. One of the advantages claimed for the vertical machine is the more complete expulsion of gas due to the small clearance made possible by use of the safety-head.

A standard form of double-acting, belt-driven, horizontal compressor is shown in Figure 7 and a section through the cylinder and valves in Figure 8. The arrangement of the valves in the cylinder heads, and the spherical form of piston, reduce the clearance to a minimum for this type of machine. Other compressors are shown in Figures 9, 10 and 11. A special form of refrigerating machine, in which water is used as the working medium instead of ammonia or carbonic acid, is shown in section in Figure 12. For temperatures above 35 deg. F., as in air conditioning and the cooling of drinking water, etc., water alone is used as the cold carrier, while for lower temperatures brine is used. The principal of operation is simply the evaporation of water under a high vacuum produced by steam jets, supplemented by the condensation of the vapor and working steam and the removal of the air and condensate by special pumps.

Referring to the illustration, a mixture of return and make-up water enters as shown, and in passing through the horizontal screen is divided into a spray, which in falling to the bottom of the chamber is greatly cooled, due to the rapid evaporation caused by the high vacuum. The steam used by the ejector and the air drawn from the evaporating chamber are taken care of by a condenser and air pump in the usual manner. The cold water or brine which collects in the bottom of the evaporator is pumped through coils located in the space or liquid to be cooled the same as has been described in the case of the compression or absorption systems.

AMMONIA CONDENSERS

An important element of both the compression and absorption systems is the condenser for cooling the ammonia gas which is under high pressure and thus changing it to a liquid. Condensers are of three general types known as the "submerged" (Figure 13), "atmospheric" (Figure 14), and "double-pipe (Figure 15).

The submerged type is the older but has been largely superseded by the other two in modern practice, except under special conditions. It is lower in first cost but does not give results which compare favorably with other types on account of the poor circulation of water, which reduces the rate of heat transmission. This makes it bulky in size when compared with the atmospheric or double-pipe outfit. The atmospheric condenser is recommended when the cooling water to be used will deposit scale at temperatures below 100 deg. F. This form of condenser is usually placed upon the roof of the building where it will be exposed to a good circulation of air. Special means are provided for causing water to trickle over the pipes, which cools them by the process of evaporation. The double-pipe condenser is recommended when the cooling water is used for other purposes and where it does not contain scale producing properties. The absence of all dampness and dripping makes it possible to place this condenser in any location most convenient.

Human Valuation

By George Kingdon Parsons

The numerous inquiries received on the article entitled "A Fair Basis of Profit Sharing," by Mr. George Kingdon Parsons, *which appeared in the February issue of* INDUSTRIAL MANAGEMENT, *evidenced such a great interest and desire for further information regarding the detailed methods involved that we have asked* Mr. Parsons *to make the following explanation.*—THE EDITORS.

THE relation of employee and employer, and the relation of worker and capitalist, are at the very root of our social unrest. In my article in February I attempted to outline a fundamentally fair and rational basis for the apportionment of profits because I believe some such method must be pursued to insure the stability of our industrial fabric. The method apportions the earnings of a business equably to stockholder, officer, clerk and worker.

The attempt is to reward the acumen and judgment of the administrator and the reliability, loyalty and industry of the employees, whether in the office or workshop.

The example used might be considered as being composite, the figures having been determined as a result of my work along these lines. The scores of industries in which I have had experience during my professional work have furnished examples of almost every variety of organization, and in every instance I have constantly been brought face to face with the common problem of adequate and satisfying reward for human effort.

This problem is as old as industry. Our professional predecessors have contributed vastly to the adjustment of this problem, but it grew so rapidly that it was impossible to keep up with it. Various methods for rewarding labor, such as commissions, piece work, bonuses, contracts, etc., and even so-called profit sharing and betterment plans, have fulfilled their function more or less satisfactorily, but when applied by those unskilled in the art, great injustices have arisen with controversies and ultimate defeat of the desired end. I have personally studied analytically the various arbitrary methods of profit sharing and find that nearly every one of them has defeated its own object in large measure because it smacked of paternalism. That there is still a place for the various methods of wage payment, as mentioned above, cannot be doubted, and yet at this time it seems impossible satisfactorily to adjust wages on any basis. The method as outlined in my article is almost totally free from the features which have defeated previous methods, and on this account I felt called upon to present it to the thinking administrative public. I termed it a proposal, yet it is barely a step further than actual methods which have proven successful in practice. This proposal, therefore, should be looked upon not as a radical thing but merely as a milestone or signpost marking a distinct era or period. The real virtue of the new method is that it is not so arbitrary and rigid as former ones, but lends itself to the fluctuating conditions which so largely affect industry at the present time.

Elements of the Example Presented

To answer some of the specific inquries, I would say that in the example shown the estimated total profit of the business would be $65,000, made up of the following elements based upon the figures from preceding prosperous years, that is, the normal profit of $25,000, a saving of $25,000 in the payroll due to elimination of drones and placing of each employee in the position where he can be most effective, and an additional profit of $15,000 due to increased productivity. This is certainly a very conservative estimate because a firm making a comfortable normal profit finds this greatly increased with a moderate increased production of output on account of the relative reduction of so-called "overhead."

Lest this seem too much like a theory, I mention the case of a client who has a business approximating the size of the one in the example and who adopted a modified form of the proposed profit-sharing scheme, together with other modern methods, and was surprised to find that his profits had jumped from a maximum of $30,000 to between $70,000 and $80,000. This profit was largely obtained through a checking and practical elimination of the so-called labor turnover (which is the curse of most businesses), together with proper control of purchasing, selling and manufacturing methods.

It is not unreasonable to say that a great many businesses at the present time hire two or three times as many employees a year as they ever have on their payrolls at one time, and in nearly every instance it costs the firm at least $50 to educate each new worker, and in many instances this cost increases to hundreds of dollars. This item alone if eliminated in the average business will pay wonderfully. This may seem an extreme statement, and yet if you sit down and calculate it for the businesses you know about, you will be surprised to learn that the amount of money wasted on the newly hired employees, if rated at $50 to $150 per man, will in many cases pay six per cent. on the invested capital. In our proposed scheme lies the means for accomplishing that which has never been gained through arbitrariness. The importance of the step must be realized when the employer takes account of the monies paid in salaries and wages. These are almost invariably the principal items of business and, therefore, are worthy of the greatest attention.

The evaluation of the human element in a particular business cannot be determined without a most careful analysis. It is apparent that it depends upon a thorough knowledge of the fitness of the employee for the position which it is proposed he shall fill in a particular organization, and therefore it is impossible for me to answer exactly and give a definite rule for applying these methods. It involves, first, a thorough comprehension and analysis of the industry as a whole, its relations to its competitors, market, etc., and a careful calculation of real past earnings, capitalization, invested capital, etc., in order that we may make with assurance an estimate of the probable future earnings when the business is thoroughly modernized and when the employees are capitalized on the proposed basis. The business in question must have a complete and accurate knowledge of costs and production. This applies not only in the factory or workshop but with the salesman, bookkeeper, correspondent, executive. The costs must become a part of the bookkeeping in such a way that the status of the business may be ascertained at very frequent intervals, as it is not practicable to defer the payment of dividends or profits to the ordinary employee because he does not have the capacity for sustained effort and deferment and because his tendency is to be skeptical and fearful lest he lose his return.

Appraisement of the Employee

The other great branch of the problem is the appraisement of the employee. The ordinary record of past experience counts for something, but you who are employers known how often you are disappointed in men with excellent records and references. You are not deceived because of the wilfulness of others, but the men somehow do not seem to turn out as satisfactorily for you as they evidently did for previous employers. The reason for this must be understood and this lies very deep, often even being hidden from the mind of the employee. Probably 75 in industry followed their occupations from circumstances and not because of special aptitude. When we realize this, then it is more apparent that the success of such a person's effort is almost wholly due to the inspiration and satisfaction with which he works, and this leads us to the fundamental understanding that is embodied in the statement "When love and skill work together expect a masterpiece."

The qualities that go to make up a man are tremendously complex and yet it is possible by close scrutiny and keen observation to analyze a man and understand him more clearly than he sees himself. There are certain cardinal mental and physical characteristics which can be determined by a visual examination made by an expert. In like manner can be determined the mainspring of the man as exemplified in what we ordinarily consider the various parts of his will, or those factors which govern his actions. The practical application of these studies taken together with his experience and history is then apparent. Knowing his various physical and mental characteristics and his experience, we know what sort of work he is able to do. Knowing his will and what might be termed spiritual characteristics, we know what he will do, provided surrounding circumstances permit. With this in mind we would place each one of our present or new employees at such work as he is best able to do, and we see that this is not necessarily that which he has always done, although in general it does have a more or less close relation with that. Instances to the contrary, however, have been very frequent. One example in particular came under my observation. A number of years ago I recommended the transfer of a shopman to a sales organization and within three months he was the best salesman that the company had; as a superintendent he had been only ordinarily successful. Relatively this difference is found down to the most menial positions, and the plan I follow is to endeavor to rearrange the organization under consideration in such a way that each employee, high or low, shall be in such a position that he is best able to increase the profits of a business with advantage to himself.

Dividing Returns Between Employer and Worker

I aim to make the conditions under which the employee is to perform his work just as suitable as is practicable for the work in question and to provide insofar as is practicable, for the satisfaction of the human requirements of the individual worker. Please do not misunderstand me; I do not mean what is ordinarily called betterment work, but I mean exactly what I say, that the employees must be surrounded by such conditions as will not only not grate upon their sensibilities but will tend to stimulate and promote their happiness and *esprit de corps.* I then provide each employee with the means to secure such information or education as he will require for the work in hand and with such tools or equipment as are necessary, and provide the management with the above mentioned means of determining the cost and production. Then with the conditions established and the worker located in that part of the organization where science and experience tell us that he can be most valuable, we make a still further study of his living conditions, etc., and determine what he must receive as a guaranteed wage or drawing account necessary for current expenses and his own fixed charges. At the same time we pay capital say one-half of one per cent. every month, and we place such a valuation capitalized in dollars upon the employee that with the estimated increased earnings he will receive a suitable stimulus or reward for putting forth his best efforts. In this way the invested capital and the employees (high and low) receive currently a minimum rate, and jointly, if success crowns the effort, they receive an additional return apportioned somewhat as in the example. The return to the individuals should amount, as stated, to from 15 to 50 per cent. of the guaranteed wages. The return to the invested capital should be, as stated, from 9 to 15 per cent., as compared with a previous average of 7 or 8 per cent. The further great gain is in the stability of the enterprise, utility of purpose, interest, and satisfaction to all concerned.

In reading the above, it has undoubtedly seemed theoretical and Utopian, but it is not. Separately the things which I have mentioned have been successfully accomplished in numerous instances and all I propose is the combining of them and applying them completely in each industry. It will be seen that this is a recognition of the supreme importance of the human element in business. To bring this home it is necessary that we evaluate this human unit. There is less and less room to-day for the proverbial stone-faced, hard-headed boss, but there is every room for the human leader.

"Passing the Buck"

By an Engineer

IN your April issue there was an article signed "A Manufacturer," asking, "What is the fundamental principle of scientific management?" which is worthy of careful consideration. The answer is simple.

The fundamental principle of scientific management (if we are justified in using such a term) is exactly the same as that of any kind of good management, namely: Authority and responsibility must be centered in the same individual. The authority to issue an order must carry with it the responsibility for the results.

The only department in which any attempt was made to apply this principle of management at the beginning of the war was the Ordnance Department under General Crozier.

In three of the divisions into which the Ordnance Department was formerly divided, namely: the Small Arms, Equipment, and Gun Carriage Divisions, this principle was at least acknowledged and to a large extent acted upon. In spite of the criticism that was showered upon the Ordnance Department and which resulted in the removal of General Crozier, these three divisions have made good to a degree which, so far as I can learn, has not even been approximated by any other department of the government.

It is certainly a fact that if all the other war activities had been carried on as efficiently as these have been, and had gotten corresponding results, we should not be in the mess we are in today.

Why under these conditions it was necessary to remodel the organization of the Ordnance Department to conform to that of the less efficient departments, I, and many others, are at a loss to understand.

A man who recently spent some time in Washington investigating the working of some of the departments, told me he found that all the people concerned with supplying the army had very specific duties or "functions" to perform. One group had to find out where material could be procured, another group to place the purchase orders, another group was to see that the material was produced, another group was to see that it was inspected, etc.; but when he asked *what individual was responsible for seeing that a specific material was properly contracted for and delivered he could not find him.*

I contend that any organization which does not clearly and definitely link responsibility with authority in an unmistakable manner is fundamentally weak. It is inconceivable that such a link does not exist; but it is also a fact, that if an intelligent man could not find it, it certainly is not given the prominence it deserves.

"Passing the buck" may be an interesting game when everybody plays it, but when we are at war with a nation that is so organized that only one man can play it, we must give it up as a popular pastime.

How to Write and Use Standard Practice Instructions in Your Shop

By Willard S. Worcester

From his experience in a plant manufacturing electrical specialties, the author describes the procedure of writing and establishing standard practice instructions. He points out that all such instructions should be written by one person to have them uniform in viewpoint; should be based upon a system of classification, symbolization and indexing; and should be complete, that is without the omission of any important detail.

Mr. Willard S. Worcester *has had 5 years of cost accounting and systematization, the first two of which were with Price, Waterhouse & Company; while the other three have been spent in the service of private corporations including the Square D Company, the firm with which he is now connected.*

THOUGH the advantages of standardized factory methods and procedure are today well recognized by progressive managers, many factory managements are reluctant or indifferent about introducing any greater degree of standard practice. One common reason for this is that there is often no one available with the time and ability to determine what changes should be made and what the standard practice should be. Heads of departments are generally too busy to take up this kind of work in the thorough-going manner that is desirable. To many managers, the cost of securing a person for this work would seem an unwarranted expense. But is not a factory likely to derive even greater advantages from this kind of standardization than from that aimed at in, for example, time-studies? Not only will the uniformity result in the saving of time to employees, but it will bring about improvement in methods having an important bearing upon the general efficient running of the plant. Efforts toward securing a greater degree of standard practice—especially in factories having a considerable number of departments whose work is closely related and which are called upon to look after a great variety of different things—are likely to be decidedly worth while.

Putting Standards in Practice

Probably, a greater drawback in the minds of most executives than the direct expense involved in revising the practice or determining what the standard shall be, is the trouble and confusion incident to carrying it into effect. Establishing any new practice involves changes which may affect a large number of employees and necessitates getting every one to do his part in a way that will permit of the smooth running of all the related features of the new procedure. In a plant where the employees have not acquired the habit of being systematic, or where they have been habitually left to do things as they see fit, the task is a particularly difficult one. That there may be the minimum of confusion and delay, it is of the greatest importance that the methods followed in instituting standard practice be most carefully considered and outlined in advance.

Broadly speaking, there are two methods that may be followed in instituting any standard practice. One is to depend upon verbal instructions; the other, upon written instructions. To obtain the best results, use should be made of both. The former, especially in the form of conferences of heads of departments is of the greatest help in securing the coöperation of those who will be called upon to execute the details of the new practice and in serving to explain its advantages and clear up misunderstandings. Such conferences will do much toward offsetting the impersonal character of an order in writing.

Personal and Written Instructions

To be lastingly effective, however, personal instructions should be backed up by written instructions—hereafter referred to as standard practice instructions or simply instructions. Verbal instructions are more easily forgotten, disregarded, or misunderstood than orders in writing, and do not carry the same weight as a typewritten standard practice instruction signed by some official of the company. Moreover, in personal instructions there is much greater liability of forgetting to explain some important detail.

The policy of avoiding verbal orders is not, however, all that is necessary. That the full benefit may be derived from standard practice instructions, there should be established some regular procedure providing for their preparation, approval and issuing. Otherwise, there is the danger that foremen and heads of departments will find themselves swamped with a great quantity of written orders, instructions, routines, etc., issued by different persons, sometimes contradictory, often changed, and not in accordance with any uniform or well-considered system. Under these conditions, it is no wonder if foremen hesitate about looking through their mass of papers whenever any unfamiliar situation arises.

This was the condition which had been reached by a moderate-sized factory manufacturing electrical specialties. The management had been making special efforts to improve and standardize its methods and had adopted the policy of always incorporating in writing any new standard practice affecting several departments. This was important, for it was necessary to secure adequate control over a very great variety of work. The company's monthly sales averaged about 300 different items of merchandise. To manufacture these it was necessary to carry a stock of more than 2000 different kinds of raw material and finished parts, over one half of the finished parts being manufactured in the plant before entering into assemblies. After a year and a half of efforts in the line of standardization and perfection of a system to meet this complicated situation, many satisfactory results had been obtained. But things were far from running smoothly. Foremen were willing to coöperate, but there was such a multiplicity of varying conditions to meet, that it was not surprising that there were constant delays encountered.

A Concrete Case

To take a concrete case: suppose an assembly department discovered certain purchased parts to be defective after these had passed inspection and been charged from the stores department against the production order for which they were to be used. In a case like this, it would be necessary to notify the cost department, so that the production order might not stand charged with the cost of these parts. The purchasing department should also be notified so that provision might be made, if possible, for charging the vendor for the defective material; the attention of the one who inspected the parts should be called to his carelessness; and some disposition would have to be made of the defective material. If the foreman took the time to look through his collection of routines, he could probably find something that would cover such a situation, but even then he would probably find that his instructions were not explicit enough to cover all details of what was necessary to do. If he relied on his own judgment, he would take much extra time in deciding in just what way to notify the various departments and what to do with the material. The other departments involved, upon being called to take action, would experience similar uncertainties and difficulties.

Features of the New Plan

What is most needed in a case like the one just described is a standard practice instruction which can be quickly found and which will explain clearly and completely everything that has to be done. It was found, in general, that neither of these requirements was fulfilled. The company, therefore, decided to start off again with a clean slate and inaugurate an entirely new series of standard practice instructions. The principal features of the plan were as follows: 1. The task of preparing instructions was delegated to one person, who was to devote the greater part of his time to this specific work. 2. A standard practice instructions form with appropriate headings was provided to be used for the first typewritten page of each instruction. 3. A system of classifying, symbolizing and indexing was devised so that any desired instruction might be readily found. 4. The policy was adopted of never omitting any detail of any importance when writing up any subject, and of keeping all instructions strictly up-to-date by means of revision and additions. 5. It was insisted upon that those receiving instructions should keep them on hand for constant reference, and follow out all provisions therein. Figure 1 shows the heading of a sheet of standard practice instructions.

Steps in Carrying Out the New Plan

The first step taken under the new plan was to appoint a person to carry it out. His method was to make a study of the work of one department after another, ascertaining in each case the methods then followed and conferring with the members of the department with the object of making improvements, wherever it was possible to eliminate duplication of effort, to introduce better forms, to provide for simpler and more direct methods, or to coördinate the work to better advantage. This study brought out the fact that there was a surprisingly large number of cases where standardization was advantageous, but where previously no one had been sure just what was the best procedure. After the conferences the standard practice thus decided upon was put into writing, and a typewritten copy of the standard practice instruction, signed by an official of the company, was sent to all department heads and others affected by the directions therein.

To distinguish the new series of standard practice instructions from all "routines," or instructions issued in the past, and from any miscellaneous notices that might be sent out in the future, the first page of each was typewritten on a special standard practice instructions form. This was headed in large letters "Standard Practice Instructions," below which were the name of the company and spaces for the following items: signature of the official approving the instruction, symbols of the departments to which copies were sent, the date, the number of the instruction, and the number of the previous instruction, if any, which it superseded. These sheets were punched to fit standard loose leaf note books, one of which was provided for everyone to whom instructions were issued. The plan of showing to what departments each instruction was sent was a valuable one, for it enabled everyone receiving the instruction to know whether or not he could count on any given department being familiar with its contents.

Classification and Symbolization

Previous experience had shown the importance of being able to lay one's hand quickly upon the instruction covering any desired procedure, hence, the following plan of classification and symbolization was originated. It will be noted that the method of symbolization is based upon the mnemonic system, as developed by exponents of the Taylor system of management. Upon examination of the instructions and routines issued in the past, it was found that these could be divided fairly readily into three main groups; viz., those describing the use of special forms, those applying specifically to the work of individual departments, and those which could not be classified under either of the other headings.

All of the new instructions in the first group were assigned the symbol NF; those in the second, the symbol ND; and those in the third, NM—the letter N in each case standing for "instruction"; F, for "form"; D for "departmental"; and M, for "miscellaneous." As every form used in the factory had a symbol, consisting of SF followed by a number and the two letters constituting the symbol of the department that made greatest use of the form, the plan adopted was to designate the instruction by exactly the same letters and figures, except that the letter N was substituted for the letter S of the form. For example, the number of an instruction describing the use of a purchase requisition—form number SF1BP—would be NF1BP.

Each instruction in the ND group was symbolized likewise, the letters ND being followed by a number to distinguish it from any others having the same sequence of letters, and by the letters constituting the symbol of the department to which the instruction referred. An instruction describing the handling of a cash fund in the purchasing department, for example, might be ND7BP. In assigning numbers, the practice for instructions in this group, and also in the NM group was to start with 1 and go up, except that in each case, the numbers from one up to a certain point were reserved for instructions of a rather general nature.

All instructions in the NM group were subdivided into five divisions: 1. Those pertaining to stores and supplies; 2. Those pertaining to tools; 3. Those which could not be classified under any other of the four divisions; 4. Those pertaining to machinery, buildings, or equipment; and 5. Those pertaining to payroll, bonus and employment regulations. The symbols for these five subdivisions in order were NMS, NMT, NMA, NMM, and NMP. (It will be noted that the last letters arranged one after another spell the word "stamp," thus adding another mnemonic feature to the scheme.) Each instruction in any subdivision was designated by a figure inserted between the second and third letters. Thus an instruction on the subject of handling scrap might be NM10S.

These instruction symbols may appear at first rather formidable to one who is not familiar with them, but it will be found that the way in which they are used is easily grasped. With all instructions symbolized in this manner, and arranged in alphabetical and numerical order, the task of finding any special one, even though the full symbol is not remembered, is reduced to a minimum. Naturally, the system would have to be varied to meet the needs of a different factory, but this can be easily carried out, even though it should be desired that instructions be designated by figures only. Still further to facilitate the finding of any desired information, provision was made for issuing from time to time a thorough index of all subjects covered by all instructions.

PREPARATION OF INSTRUCTIONS

Much care was taken in preparing each standard practice instruction to see that every detail was clearly and fully described. This had the result of making many ot the instructions rather lengthy, but it was believed to be better to err in this direction, rather than leave anything to guesswork. The disadvantage of length was to a large extent offset by providing descriptive titles to all paragraphs in instructions which exceeded several pages. Whenever any standard practice was changed, either a new instruction was issued to take the place of the old one, or the change was described in a special instruction having the same number as the original one, but followed by the word, "Corrections." In such cases, notice was sent out to destroy the original instruction or to mark it "Superseded" or to make a marginal note referring to the changes described in the special instruction.

An important part of the general plan for these instructions was insisting that they be lived up to. Conferences were frequently held when any new procedure was to be put into effect; the importance of following out all the provisions of the instruction was emphasized at these and all other occasions. If this was found to be impossible or impracticable, the matter was to be referred to the official who approved the instruction. Whenever any instruction was sent out, it was always accompanied by a special receipt, to be signed by the one receiving the instruction and then filed according to his department. The return of the receipt showed that the instruction had been properly delivered and helped to create a greater sense of responsibility for seeing that its provisions were carired out. Anyone who had received and signed a receipt for an instruction was strictly to blame if, thereafter, he failed to comply with all the directions therein.

Experience has shown that no part of the plan is impracticable. A factory which has all its departments written up in this way posessses a record describing the procedure to be followed on every kind of routine work. Furthermore, the scheme of classification, symbolization and indexing makes it possible to find at once any desired information. Standard practice instructions such as these simplify greatly the task of breaking in new men. The time and expense which is consumed in their writing and issuing is regained many times over, for they do away with a vast amount of wasted effort spent in seeking and giving special directions and in doing things wrong.

The Manager and His System

By H. L. Gantt

A MANAGER can do his work efficiently only when he can clearly grasp his problem as a whole. The mechanism which enables him to do this is a *system of management.*

A system of management, however, is useful only when a manager supplies the motive power. It can do nothing of itself.

The object of such a system, like that of a machine, is to accomplish a specific purpose. The ideal system of management, or ideal machine, is the one which actually accomplishes the desired object in a minimum time with the minimum expenditure of power or energy.

The tendency of modern machine design is to provide a machine which will do automatically those things which have been standardized, and thus enable the operator to concentrate his energy on things requiring judgment and discretion. In a similar manner a modern system of management should present ascertained facts in such a manner as to make perfectly obvious all operations which depend upon such facts, leaving the executive free to concentrate his efforts on those operations or policies which depend upon facts not accurately or entirely available, and for the utilization of which he must rely upon his experience and judgment.

Modern managers rely upon some kind of a charting system, which in its best development shows not only what has been done in the past compared with what should have been done, but also what should be done in the future.

Charts of this type, if kept in sufficient detail, indicate with great accuracy the probabilities of future performance, and enable the executive or the manager to anticipate needs and make preparations therefor. Such charts are in existence in some manufacturing plants, in the Ordnance Department, U. S. A., and are being introduced into other branches of the government. They have been eagerly welcomed by those in charge wherever their value as a managerial mechanism has been recognized.

Used as tools of management, they produce results heretofore unobtained; but viewed as mere statistical stunts, they are simply an improved method of visualization.

So far the charts above referred to have not only been based on the same principle, but are so nearly alike that a man familiar with those in one department can readily read those in any other department. There is every reason to believe that if this, or a similar, system of charting were extended to all the activities of the Federal Government, a series of master charts could be made which "assembled in one clearing-house, would give the data necessary in order to make the whole program of war production move with fair uniformity, without disastrous competition and with justice to the worker." Such a charting scheme would be really *a system of management, by means of which all activities concerned with the war could be harmonized.*

Mr. F. L. Sweetser, General Manager, The Dutchess Manufacturing Company, requests information in regard to methods of remunerating factory inspectors by some system of quality piece work.

INDUSTRIAL MANAGEMENT will be very pleased to receive information from any of its readers who have tried such a system of payment, together with details of how the piece work was planned and paid for and the general character of the results obtained.

There were 37 steel shipyards in America at the time of our entrance into war. We have located 81 additional steel and wood yards, while 18 other yards have been expanded. Does America realize what this job means? Does it realize what a tribute is paid to its own initiative in this achievement?—*Edward N. Hurley.*

Under New Management—From Old to New

Change in Mental Attitude is the New Element in Management

By Charles M. Horton

It is almost a commonplace to say that management begins at the top. The viewpoint and mental attitude of managers of the old school must be changed over before the new methods can be put into successful use. In narrative form Mr. Horton *pictures this change.*

Mr. Charles M. Horton, *member of the American Society of Mechanical Engineers, was educated in the public schools of New York City and at the University of New Mexico. He served a drafting-room apprenticeship and has had twelve years' experience in designing special machinery. During a part of that period he was in the employ of the Westinghouse Machine Company, and was personal designer to Mr. George Westinghouse in the gas-engine division. As an avocation he has pursued literary work for years, writing for both fiction and technicol publications.*

THE old manager sat in his sanctum, entirely surrounded by calm. The room was square with large windows on two sides. The walls were panelled, and the floor, which was of hardwood, was covered with a Kirmanshah rug. The desk was of mahogany, and save for the double glass inkwells which were closed, and the blue desk-blotter which was spotless, and the very select assortment of pen-holders, which, as with the other features, were for decorative purposes, the desk was as free of letters and papers as the surface of the woodland lake. Embedded in the front of the desk, and just underneath the top, was a row of push-buttons, each leading to outer offices and to certain subordinates. Large oil-paintings in sombre frames hung upon the walls, and the windows and doors were draped. The chairs were deep-seated and leather-covered, and revealed evidence of a rich refinement of selection. A faint aroma of tobacco filled the room, for the old manager, just now as motionless as a mummy, was seated squarely before his desk, his forearms upon the arms of his chair, in one limp hand a cigar. Up from the cigar a thin, blue-gray streamer of smoke was curling lazily. The man was staring into space and there seemed to be absolutely nothing on his mind.

A new era is breaking in industry. Industrial management is occupying the thoughts of men today almost to the exclusion of other factors in business. Industrial conditions are changing with amazing speed and ideas that would not have been entertained a few months ago, and actions that would not have been thought possible are becoming realities. Yet, in the face of our national struggle, labor and capital are not working as one, are not shoulder to shoulder—and this in spite of the great fact that one is dependent upon the other, as the other is dependent upon the one. The attitude of each toward the other is not that of meeting upon a basis of human relationship, but rather on the battlefield of industrial strife. Yet there is a remedy. It lies in establishing just human relations between these two opposed forces. New management will do this, for it will be essentially human—and its representatives very much so.

THE SATISFIED MANAGER

There wasn't. Things were going all right. Indeed, they had been going all right for some time. Business was good; the organization was perfect; workmen everywhere were satisfied. Though an old manager, old in the business, the old manager was not an old man. Quite the contrary. He was a young man, or fairly young, perhaps fifty-five. Which is not old. His face was round and aglow with health, and his gray moustache, trimmed short, bristled with latent activity. His eyes were gray-blue, the precise shade of the streamer of thin smoke curling upward from the tip of his slow-burning cigar. His heavy eyebrows were shaggy and gave evidence, as did his moustache, of grim power in the man.

It was late afternoon. An hour more, and he would be free. The time dragged. Yet he did not move. forearms still resting upon the arms of his chair, eyes still staring vacantly into space, the man continued motionless as a mummy.

Suddenly a door opened silently and a clean-limbed, cleancut young man stepped into the sanctum. The young man was the old manager's secretary. He was the sole source of communication between the manager and the plant—indeed, with the outside world during business hours. For the old manager was sufficiently advanced to have long since had the telephone taken out. Telephones annoyed and, after all, telephones were unnecessary. Communication could be maintained, and was maintained, through a unit of life—the secretary—and this eminently sufficed. Then, too, modern methods demanded it, since efficient management consisted chiefly in protecting one's self from petty annoyances. The secretary stood at polite attention beside the manager.

THE APPEAL FROM THE WORKS

At length the man seated before the desk bestirred himself slightly. This, as the secretary knew, was acknowledgement of his presence. He cleared a trembling throat.

"A committee of workingmen to see you, sir," he said.

The manager remained motionless. Yet his eyes turned swiftly in the direction of a secret door which opened upon a private passageway leading to the street. Obviously it was in his mind to "beat it." Yet something restrained him—something held. Again he moved slightly, and half-turning in his chair, lifted his cigar and drew a long, contemplative puff of smoke from its fragrant round. Exhaling the smoke, he looked up at the secretary, still beside him, still obsequious.

"What do they want?" he demanded, gruffly. "I don't want to see workmen—not now." It was too close to quitting time, you know, though he did not say this.

The secretary turned and waited.

"Tell those men I will see them," came the curt decision.

A Workmen's Committee

The committee entered, some of them, the more daring and unconcerned, in overalls and jumper; others, less sure of themselves, bearing evidence of hasty cleaning—collars and neckties and coats all correctly adjusted. The leader, or spokesman, a man with gray hair and a youthful, clean-shaven face, advanced beyond the group, and approaching the manager, laid a carefully typewritten sheet of paper down upon the mahogany desk.

It was a polite demand for an increase in wages. The scale asked for was clearly set down alongside the several trades represented in the establishment—thusly: machinists, so much; patternmakers, so much; molders, so much; tinsmiths, so much; and the helpers. The paper was signed with scrawling and cramped signatures. It closed with an appeal to the effect that the new scale be put into effect the first day of the following month—a postscript.

Refusal of the Appeal

"Gentlemen," began the manager, carefully selecting his words, and even more carefully enunciating them, "I regret to see this. I say this out of no selfish interests on my part. We are at war. Sacrifices must and shall be made. You have asked for an increase in pay. I, in my turn, as representing the welfare of this organization, must deny you this demand. It reveals nothing of willingness on your part to make needed sacrifices. You have your bonus, both weekly and semi-annually, and we have voluntarily increased your rate of pay 20 per cent. in the past two years. We can do no more. I very much regret this, but it cannot be otherwise. I bid you good day."

"Provisions and rent—" began the spokesman, only to be interrupted.

"I know—I know all about that," snapped the old manager. "We all are suffering. It is a just suffering. We are in a state of war, and Sherman was as well advised as anybody concerning what that state is." Which was by way of being a little tart humor on the part of the old manager. "I can do nothing for you," he added, conclusively, his cold eyes bulging slightly under the strain of grim determination in the man. "I bid you good day."

The spokesman of the committee wavered a moment. The unresponsive attitude of the old manager was having its effect upon him.

Cause of the Appeal

"We ask this out of no personal selfish interests," he declared, quietly. "We ask it out of painful needs arising in our private lives. We do not want this additional money to give to rum keepers, nor to theater owners or movie houses. We do not want it to stick in the banks. We do not want it for gasoline for our cars, nor for rides on the trolleys. What we do want it for, however—what we find imperative need for it for—is to pay our just obligations: store bills and rentals and the like. We have children—we all have children—and we wish to keep them alive and in school, and sufficiently clothed to admit of their attending school."

"I can do nothing for you," repeated the old manager, evenly. "We have done all we can for you. An organization of this kind can do only just so much. We have done the maximum that is possible with us for our employees. That is final, gentlemen," he concluded, and turning back to his desk, reached out a hand mechanically in the direction of the place on his desk where his half-smoked cigar usually reposed, only to draw his hand back again quickly. Finally he said, coldly, "I bid you good day."

Loyalty to the Country's Needs

The committee stood motionless, silent. The quiet of the sanctum was heavy with brooding. The men had reached the end and knew it. They had failed in their request. Three ways remained open to them. One was to quit the job; another was to instigate a strike; the third was to go back to work. It should be this last. For the government was at war, and the homes of mankind were at stake, and war leaned its heaviest weight upon industry always. There should be no strike, then, either collectively or individually. No man would quit his job.

The Manager's Dream

After the committee had left, and when the door was closed, the old manager sat back in his chair. He sat back comfortably, with his fingers clasped over his ample stomach; and he half closed his eyes. His motor would not be along till four thirty.

His telephone rang—for he had a telephone on his desk, had this new manager. He jounced forward in his chair and unhooked the receiver. He recognized the voice of one of his most competent machinists. The man was saying:

The Machinist Calls the Manager "Jim"

"Jim, I'm coming up to have a chew with you—What? No; not tobacco—just a little skookum talk—Injun powpow. It's big medicine, though, Jim, as you'll learn when I get up there in your office. Shoo everybody out—that place is usually so cluttered with folks a man has to elbow his way in—and prepare to give me the floor. Get me?"

The new manager laughed.

"I get you, Tom. The latchstring is out. I'm waiting."

Within five minutes a man in overalls stepped confidently and smilingly into the new manager's office. It was Tom, boss machinist. His countenance radiated health and satisfaction, and there was an eager light in his eyes which told of the hope of many things that yet would be accomplished. After a time he began to speak.

"Jim," he said, sniffing slightly, "where do you get this brand of cigar? Do you buy these for the help or do you actually smoke 'em yourself?"

Again the new manager laughed. He held up his own "smoke."

"Both out of the same box, Tom," he declared. "Is that what you came up to ask me?"

The machinist uncrossed his legs. His countenance grew sober. He leaned slightly forward in his chair.

Tom Tells the Manager Wages Need Readjusting

"Not exactly, Jim," he said, quietly. "It's about some of the boys. I'm up here unofficially, too, Jim—I want that to sink in. The boys would hate to think I mentioned it to you, I know. So do you. So keep it under your hat. But there's got to be some little readjustment in the scale, I guess. Provisions and rents keep moving along, and while you are doing fine with us in the matter of wages as it is, yet I guess you've got to keep humping the scales along, too, or go under. The boys aren't kicking—understand that. They know you and they know you'll do what is right. It's just a little word I hear let drop here and there that makes me feel you've got to do something again."

The Small Margin of Profit

"Tom, you've asked me something. I'm afraid I can't grant it—not just now. Yet I appreciate your needs and the needs of the men. I'll tell you what you do," he went on, sitting forward again. "Suppose you call a group of the men together—make it official; I'll write the letter—and have them come up and see me. I'll arrange to get the books in here and they can see for themselves just where we stand in this thing. You'd be surprised yourself, Tom, at the small margin of profits under which we're running at this moment. Another boost to you fellows, and we'll have to close up shop, with competition as strong as it is, and everything shaded to a hair-line. You know me, Tom. I'll get you the books right now, if you say so. We can't do it and keep the wheels turning. But call your men together," concluded this new manager, "and get 'em up here. I'll have the head bookkeeper and the books and a box of these rotten cigars, and we'll all go over this thing together. Glad you spoke, though—I want you always to do that." He was silent. "Was there anything else?"

Bill Toomey's Accident

"Yes, there was," said the machinist. "Bill Toomey got hurt this morning—picked up in a belt. He went to the hospital."

"Gad!" breathed the new manager, his countenance again revealing distress. "Strange, I had heard nothing about it!"

The other twisted uneasily about in his chair.

"We thought it best not to let you know. You've got enough troubles."

The new manager reached out and unhooked the receiver of his telephone. "To hell with that, Tom; I want to know all these things." Then he called for and was connected with the bookkeeping department. "Say, fellows," he began, responding to a voice, "I've just heard something. Bill Toomey's in the hospital. I want you to send a month's wages right up to his wife, and keep it going as long as Bill is laid up. At once, understand?" Then he rang off; called for the hospital; began to talk again. "You've got a man of mine there—Bill Toomey. Now, Doc—this is the New Era Manufacturing Company speaking—I want you to give that man the best of care and send the bill to us. Got it? Good! A private ward—nurses—the whole works. Good! Goodbye!" With this he turned back to the machinist. "Tell me how it happened."

The machinist told of the accident. Then he arose to go. The new manager looked at him searchingly.

A "Bull in the China Closet"

"Anything else on your mind, Tom?" he asked, sympathetically. "Shoot it out, if you have! That's what I'm here for."

The man hesitated. Evidently there was something more, but also it was evident he did not like to speak about it. Finally, however, he blurted it out.

"You've got a skunk of an assistant superintendent!" he said. "I didn't come here for that; but you pressed me, and there it is."

The new manager uttered a low whistle of surprise. Then suddenly his face sobered. He regarded the man with steady eyes.

"Is that your personal opinion, Tom," he asked, pointedly, "or is it the opinion of the men as a whole?"

"It's the opinion of the men," declared the other with conviction. "He's only been here about two months, as you know, but already he's got the animosity of the whole erecting floor. He's dominating —a kind of a bull—and he thinks he's running the establishment. He—"

"Wait!" interrupted the new manager. "I'll get the facts myself. What else is on your mind? I want you to know I appreciate all this, Tom. Let's have the rest—if there is any."

The machinist bit his lip.

"You understand I didn't want to preach on that assistant superintendent," he said, obviously troubled. "You asked me and I told you."

Human Relationships

"How about that change we made in the location of the work benches? All right? How are the men taking it?"

The machinist looked pleased.

"Oh, that!" he burst out. "That's fine! Already two men have taken off their spectacles. The light is right, now, on the benches, and the men work a great deal more accurately. A good move, that, Jim."

"I'm glad of that," rejoined the new manager, reflectively. He was silent. Suddenly he looked up again. "Didn't see you in the company's reading room last night. I beat that wop helper the best game of chess he ever played. I believe he wanted to lick me, he was so sore. Where were you?"

The machinist laughed. Then he stared thoughtfully at the floor.

"My wife had a spell again—I had to stay home and take care of the kids."

The machinist looked as if he wanted to ask a question. Finally he did ask it.

"By the way, Jim," he began, "I've always wondered about that. What do you do about a man's time when he's out like that? You don't charge it to the job, do you?"

"Nope—that wouldn't be fair; would it? It goes against us—the organization. Don't worry about that, Tom. Everything is all right and above board. You lay off when in your heart you know you should. Men don't take advantage of things like that."

"I guess that's all, Jim," he said. "You write your letter, and I'll get the boys together. I doubt if they'll carry it to a head, though."

The new manager turned to his desk.

"We'll write the letter, nevertheless," he rejoined. "I'll call the stenographer right now."

The machinist nodded and withdrew.

* * * *

The old manager—I say the *old* manager—drowsing before his mahogany desk, awoke with a start. He sat up and blinked dazedly about him. His fingers were yet clasped over his ample stomach, and he found the room still overly warm. He consulted his heavy, old-fashioned watch. It was four-thirty. He listened for the footsteps of his secretary. The man never had failed him, nor did he fail him now. In at the door silently he stepped; approached the old manager with due obsequiousness; stood at polite attention beside him. The old manager bestirred himself slightly

The secretary, knowing this for what it was—acknowledgment of his presence—repeated the usual formula covering this particular occasion. He said:

"Your motor is waiting, sir."

Employment and Labor Maintenance

A Special Department to Aid Employment Executives

Standardized Occupations and Rates

By W. D. Stearns

Secretary, Occupation and Rate Committee, Westinghouse Electric and Manufacturing Company

THE growth of industry has demanded standardization, so we have standardized materials, machines and methods.

War conditions have emphasized the importance of men as compared to materials, machines and methods, with the result that we are all thinking seriously about standardizing conditions having to do with the manpower of industry. The purpose is to enable the employee to use his ability to better advantage for himself and his employer. The growth of manufacturing has also demanded a centralized employment department and this, in turn, requires standard conditions in regard to employees.

The Westinghouse Electric and Manufacturing Company, Pittsburg, Penn., employs 20,000 operatives. The plant is made up of 16 departments, each being practically a separate factory with its own superintendent and foremen. All of these superintendents report to a general superintendent. Many of these departments have occupations that are very similar, often exactly alike. If an employee in one department is paid more or less than an employee in another department who renders exactly the same service, then there is dissatisfaction and a decided tendency to shift from department to department. The serious labor problem throughout the country does not seem to be so much a shortage of labor as a shortage of men who will remain at one job long enough to become efficient producers.

Doubtless, a most important factor in this present large labor turnover is just this non-uniformity of wages and occupations between various manufacturers in a district. An employee feels that he may perhaps do better and determines to try his luck elsewhere. The employer has no method of comparing his own with other employers' occupations and rates and thus convince the employee he cannot better himself. Consequently the man does not stay long enough in any one place really to develop himself into his true worth and is doing both his employer and himself an injustice.

The Westinghouse Electric and Manufacturing Company had this same difficulty between its various departments and decided to analyze, classify and standardize its occupations and rates. An Occupation and Rate Committee was appointed to carry on this work.

Because of the nature of its work, this company uses practically all of the occupations common to the metal trades, and many peculiar to the electrical industry.

An original list of over 400 distinct occupations was finally condensed into about 170 which were adopted as standard. It was the aim to have as few as possible and still have a specific occupation where the work was peculiar to that job. Care is taken to use these standard names on all forms and records dealing with occupations. Each occupation is given a number. The list follows:

STANDARD OCCUPATION TITLES

1. Auto Truck
2. Automatic Sleeve Machine
3. Babbitter
4. Balancer, Running
5. Balancer, Static
7. Bander, Rotor
84. Battery Repairman
8. Belt Maker
9. Blacksmith
10. Blacksmith, Helper
12. Boiler Cleaner
11. Boiler Maker
17. Bolt Forging Machine
16. Bolt Pointing Machine
15. Bolt Threader
13. Boring Mill, Horizontal
14. Boring Mill, Vertical
20. Box Maker
21. Box Marker
18. Boy or Girl
26. Brazier
22. Bricklayer
25. Buffer
165. Bull Block Man
24. Bull Dozer
27. Cabinet Maker
28. Carpenter
30. Centering Machine
32. Chauffeur
29. Checker, Car
31. Checker, Materials
23. Chipper
33. Coil Assembler
34. Coil Winder
40. Coiling and Bending Copper
35. Coils, Form and Pull
19. Connector
39. Coppersmith
36. Core Builder
37. Core Maker
38. Corrugating Press
42. Coslettizer
43. Craneman
44. Cutting Off Machine
45. Cutting Off Saw
46. Die Casting Maker
47. Die Maker
163. Draw Bench
49. Drill Press
164. Edging Machine
50. Electrode Maker
52. Elevator Man
51. Elevator Man, High Speed
53. Emery Wheel Dresser
54. Enameling
55. Engineer, Stationary
59. File Cutter
60. File Sharpener
58. Filer
64. Fitter
62. Former Hand
63. Furnace Man
65. Galvanizer
66. Gear Cutter
67. Grinder
69. Hammerman, Bradley
71. Hammerman, Drop
70. Hammerman, Steam
73. Hammer Operator
68. Handyman
172. Heaterman
74. Helper, Machine
75. Hoop Rolling Machine
57. Hostler, Railroad
173. Ingot Machine
79. Inspector, Equipment
80. Inspector, Production
81. Instrument Maker
61. Insulator
87. Lamp Trimmer
88. Lathe, Engine
89. Lathe, Turret
90. Layerout
82. Locomotive, Electric
94. Machine Tool Setter
174. Machinist, Journeyman
92. Marble Driller
93. Marble Enameler
91. Marble Worker
95. Material Cutter, Insulation
97. Mica and Composition Worker
98. Micarta Worker
96. Milling Machine
99. Millwright
102. Motor Tender
100. Mould Setter
104. Moulder, Bench
105. Moulder, Floor
103. Moulder, Machine
101. Moveman
107. Oiler
108. Packer
111. Painter
110. Pattern Maker, Metal
109. Pattern Maker, Wood
112. Pipe Fitter
113. Planer
114. Plater
115. Plumber
116. Polisher, Metal
77. Press, Hydraulic or Pneumatic
78. Pumpman
118. Punch Press
161. Repairman
119. Rigger
120. Riveter
167. Roller, Cold
166. Roller, Hot
168. Rougher
6. Saw, Band or Circular
121. Saw Filer, Hand
122. Saw Filing, Machine
124. Screw Machine, Automatic
123. Screw Machine, Hand
125. Set up for Test
76. Sewing Machine
126. Shaper
127. Shearman
128. Sheet Metal Worker
171. Shipper
129. Sign Writer
130. Slater
170. Slitting Machine
131. Slotter
132. Solder Pot
133. Spring Maker
135. Stockman
134. Stockman, In Charge
137. Stoker
136. Storeroom Attendant
169. Straightener
138. Structural Iron Worker
106. Switchboard Mounter or Dismantler
139. Switchboard Operator
83. Switchman, Industrial
160. Taper
175. Tester, Electrical
140. Tester, Mechanical
141. Tinner
142. Tinsmith

146. Tool Dresser, Wood Worker
143. Tool Handler
145. Tool Maker
144. Tool Temperer and Hardener
148. Trackman, Railroad
149. Transformer Mounter
147. Treat, Dip and Insulate
150. Undercut Commutator
85. Unskilled Workman
    Ashman
    Auto Truck Helper
    Coal Handler
    Coil Separator, Copper
    Die Casting Maker, Helper
    Dipper, Acid
    Dipper, Plater
    Freight Handler
    Grinder, Rough
    Hook on Crane
    Janitor
    Lumber Handler
    Marble Worker, Helper
    Magnetic Separator
    Material Handler
    Millwright Helper
    Oil Separator and Washer
    Pickler
    Pipe Fitter, Helper
    Plumber, Helper
    Sand Blast Operator
    Sheet Steel Handler
    Slater, Helper
    Stoker, Oiler
    Structural Iron Worker, Helper
    Sweeper
    Trucker
    Wheelbarrow Man
    Wiper
151. Water Tender
155. Weigher
152. Welder, Arc
153. Welder, Butt or Spot
154. Welder, Oxy-Acetylene
159. Winder
158. Wireman, Apparatus
157. Wireman, Shop
156. Wood Working Machine

Occupation and Rate Books

The rates paid for every occupation and the number of men on each occupation were tabulated for every department. It is needless to say there were many discrepancies and inconsistencies. These were corrected and two books made up. The foreman's book shows all the occupations used in his section and range of rates he is authorized to pay. The superintendent's book shows, for every occupation in the works, all the sections using that occupation and the rates of pay authorized.

In other words, the foreman's book shows the occupations used in his section and the superintendent's book shows all the sections that use each occupation. A sample page from each is shown in Figures 1 and 2.

The most logical arrangement for classification of workers is based upon the value of the employee to the industry in his particular occupation. All those receiving substantially the same rate should be included in the same class regardless of occupation.

With this in view Classes A, B, C, D and E were established. In general, the qualifications for the different classes are:

Class A. Leaders in charge of groups, experimental workers and those on the highest grade production or tool work. A general knowledge of machine tools, speeds, materials, etc., judgment, accuracy without the use of jigs and a high degree of skill and dependability are required.

Examples. A. Engine lathe, planer and boring mill operators on very large work where great loss is incurred if mistakes are made.

Class B. Accurate, dependable workers with considerable ability and experience without the thorough knowledge or experience required of those in Class A. Generally operators on accurate or heavy work which is usually repeated. Accuracy, knowledge of speeds and materials, reading of blue prints and use of gages are required.

Examples. B. Engine lathe operators, work not especially accurate but laborious; work on smaller lathes where responsibility is great, as on commutators and collectors after being assembled on shafts. Planer operators on medium sized work, much repetition. Vertical boring mill operators on large work accurate difficult work on smaller mills.

Class C. Workmen who have become proficient on lines of work which are usually repeated.

Examples. C. Engine lathe operators on repetition work and on roughing shafts. Planer operators on rough work such as roughing stock for poles. Boring mill operators on small repetition work.

Class D. Workman who can be brought in a short time to be efficient producers on lines of work which are usually repeated.

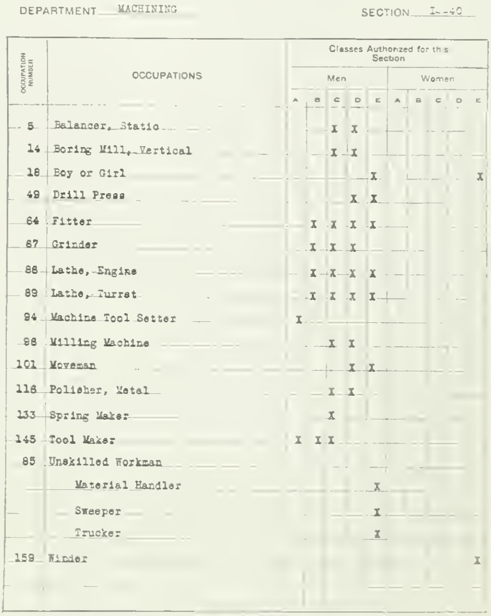
Examples. D. Employees learning to operate engine lathes, planers and boring mills, learning winding.

Class E. Unskilled workmen with little, if any previous training; men on work requiring a small degree of skill, accuracy or knowledge.

Examples. E. Unskilled workmen, such as truckers, sweepers, material handlers and machine helpers.

Rates of Pay

Because of the varied classes of work, several different wage systems are used including straight day work, piece work, premium work and various bonus systems. The word contract is used to designate any form of wage payment other than straight day work. The straight day work system is used only where the nature of the work makes it necessary, or while a beginner on contract work is learning the job.



DEPARTMENT MACHINING SECTION I--40

OCCUPATION NUMBER	OCCUPATIONS	Classes Authorized for this Section									
		Men					Women				
		A	B	C	D	E	A	B	C	D	E
5	Balancer, Static			X	X						
14	Boring Mill, Vertical			X	X						
18	Boy or Girl					X					X
49	Drill Press				X	X					
64	Fitter		X	X	X	X					
67	Grinder		X	X	X						
88	Lathe, Engine		X	X	X	X					
89	Lathe, Turret		X	X	X	X					
94	Machine Tool Setter	X									
98	Milling Machine			X	X						
101	Moveman				X	X					
116	Polisher, Metal			X	X						
133	Spring Maker			X							
145	Tool Maker	X	X	X							
85	Unskilled Workman										
	Material Handler					X					
	Sweeper					X					
	Trucker					X					
159	Winder										X

FIG. 1. SAMPLE PAGE FROM FOREMAN'S BOOK

A range of rates of pay is given for each class to allow for normal increases, such as for increased efficiency or long service. The minimum rate authorized for an occupation is in general the maximum hiring rate for that occupation. The higher rates are to be used only for the most skilled in that class. The higher class occupations requiring skill, experience, or special ability, should be filled by promotion or transfer from another department whenever possible.

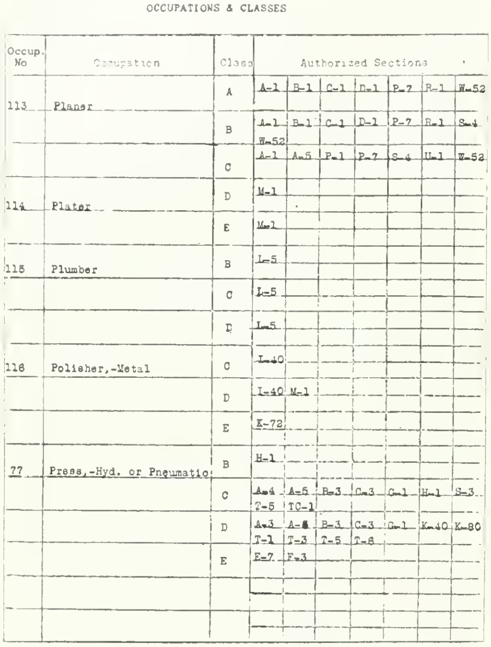
A key sheet is issued for each book. This key sheet shows for each class (A, B, C, D and E) the range of hourly rates for day work, contract work and special instruction period. In case of a need for a straight line increase or decrease, the range of rates included in each class can be revised on the key sheet; thus saving the trouble of making individual corrections in the 125 foreman's books and in the 25 superintendent's books.

If it is deemed necessary to raise an individual's rate above that included in the range of the class authorized for that occupation, the matter is taken up with the Occupation and Rate Committee. This occupation may then be classified to meet the conditions, or the employee may be promoted to an occupation which requires a higher class man.

It is the duty of the Occupation and Rate Committee to establish new occupations or rates, approve all changes in rates and investigate any unusual conditions that may be due to rates of pay.

The two *fundamentals* of this plan are:

1. The determination of definite names for standard occupations.
2. The classification of workers in accordance with their value to the industry, regardless of occupation.



OCCUPATIONS & CLASSES

Occup. No	Occupation	Class	Authorized Sections						
113	Planer	A	A-1	B-1	C-1	D-1	P-7	R-1	W-52
		B	A-1 W-52	B-1	C-1	D-1	P-7	R-1	S-4
		C	A-1	A-5	P-1	P-7	S-4	U-1	W-52
114	Plater	D	M-1						
		E	M-1						
115	Plumber	B	L-5						
		C	L-5						
		D	L-5						
116	Polisher,-Metal	C	I-40						
		D	I-40	M-1					
		E	K-72						
77	Press,-Hyd. or Pneumatic	B	H-1						
		C	A-4 T-5	A-5 TC-1	B-3	C-3	G-1	H-1	S-3
		D	A-3 T-1	A-[illegible] T-3	B-3 T-5	C-3 T-6	G-1	K-40	K-80
		E	E-7	F-3					

FIG. 2. SAMPLE PAGE FROM SUPERINTENDENT'S BOOK

The two *ideals* of this plan are:

1. Uniform rates of pay for uniform service, thus preventing the discontent that might arise due to non-uniform wages.
2. To maintain wages for each occupation within a certain range and, when an employee reaches the limit of that range, to facilitate his promotion to an occupation of higher value.

The company maintains a relief department, a savings fund, a pension system, and the other institutions usual to a large concern, for the mutual benefit of itself and its employees. In addition to these, there is a well organized, centralized employment department. It is believed that, though all these are necessary, the thing that counts most is a just and consistent compensation for service.

If the various industries in a district were to standardize their own occupations and rates, they might then be able to get together on common ground and do something toward standardizing occupations and rates for the district. This would help each industry to keep its own men long enough for them to become specially trained and to grow to feel that they were a part of the organization.

Furthermore, it would result in the formation of a sort of labor exchange system, of considerable advantage to the industries in any particular region and give employers better control over the maintenance of the working force.

War Emergency Courses in Employment Department Practice

By Roy Willmarth Kelly

Director, Bureau of Vocational Guidance, Harvard University, and Author, "Hiring the Worker"

THE unparalleled expansion of industrial enterprises engaged in war work has brought into sudden prominence the necessity for systematic methods in dealing with employment problems. Many of the labor difficulties that have arisen in our ship yards, munition plants, and manufacturing establishments could have been avoided if an organized effort had been made to foresee and prevent conditions which are sure to cause dissatisfaction and slow up production because of an unstable working force.

Government departments have not hesitated to call into service high salaried executives who could contribute to better efficiency in mechanical lines. Raw materials, methods and machinery are being carefully investigated and standardized. Experience has shown, however, that the principles of true scientific management have been most successfully adopted by concerns that have not neglected Frederick W. Taylor's clear statement of the need for the scientific selection, training, and treatment of employees.

Some beginnings are being made in industrial training to meet our war demands. Recent measures passed by Congress, and such steps as the organization of the General Service Department of the Emergency Fleet Corporation to have charge of housing, transportation and welfare of shipyard employees, point to hopeful solutions for some of the most urgent problems. But the lack of trained personnel executives has made it difficult to insist upon the introduction of effective measures in dealing with the selection, promotion, rating, discharge and general welfare of employees.

TROUBLES OF THE AMERICAN INTERNATIONAL

The troubles of the American International Shipbuilding Corporation will serve to illustrate the general situation. During the first five months of construction, over 100,000 men were passed through the employment office, although the total number remaining on the payroll was only 20,000. Even at the end of February, the number of employees hired daily was between 600 and 700. During the early period of construction, it was nearly impossible to locate the relatives of men who were injured or killed on the Island because of the inability of the Employment Office force to cope with the mass of records for the thousands of men who were being turned into the plant. Although conditions at Hog Island have been given considerable publicity, they are probably no worse than those which obtain in other establishments where the emergency has called for like haste in expansion.

The Industrial Service Sections of the Ordnance and Quartermaster's Department and of the Shipping Board, as well as the Adjutant General's Office and the Department of Labor, have come to the view that the variety of methods, or rather the absence of any method, of dealing with workmen in war factories as new conditions demand, is responsible for high labor turnover and other industrial difficulties. These government agencies, having in mind the beneficial results that have come, both to the management and to the workers, from the establishment of employment departments in factories, are urging the more general adoption of this form of organization.

Even before the war the demand for well trained employment managers was increasing faster than the supply, and the exigencies of war work have emphasized the tendency. The decision of the Government to stimulate this demand still further will create a marked dearth of employment managers, with which only the Government can deal.

Intensive Training Program

This situation has led these government agencies to coöperate in a program of intensive training in employment-department practice. They have asked the Storage Committee of the Council of National Defense to arrange with the colleges of the country for a special six-weeks' course in this work. Several universities will be asked to conduct schools in industrial centers where good employment offices may be studied as laboratories, at the same time that theoretical lectures and discussions are carried on under the leadership of competent instructors. These courses will be planned and supervised by the Government, and, so far as possible, the students will be recruited by the Government with the help of business men.

The Rochester Course

The first of these courses was offered by the University of Rochester, beginning March 25. The University has given the use of its equipment and the services of its teaching staff to carry on this work. The course will be given at the University but under the general direction of officials at Washington. The purpose is not to turn out a finished and perfected employment manager, but rather to give the prospective employment manager the correct viewpoint, and to familiarize him with the essentials of what experience has proved to be successful practice in the leading departments throughout the country.

The coöperation of the business men of Rochester has been secured to help make this course a successful one from a practical standpoint. They have offered the use of their plants for visitation and inspection. The Young Men's Christian Association has also agreed to coöperate by offering athletic and recreational facilities and a room for evening discussion, as part of the regular schedule.

A second course offered in Boston is beginning April 22. Harvard University, The Institute of Technology, and Boston University coöperate in giving the instruction and in making the necessary arrangements, while the Boston Employment Managers' Association assists by opening their concerns to students for observation and practice.

What the Course Includes

A complete outline for this intensive training was drawn up by Captain Boyd Fisher of the Ordnance Bureau, formerly President of the Executives' Club of Detroit.

The knowledge and viewpoint which it is desired to impart to the students is given through (a) lectures, (b) factory visitations for illustrative purposes, (c) conferences and discussions, and (d) actual experiences in employment offices. Each of the foregoing methods consumes approximately one-fourth of the total time.

The subject matter and the relative time devoted to the various subjects, is as follows:

Subjects	Percentage of Total time
Employment department practice	80
Labor economics	10
Industrial organization and management.	5
Statistics as applied to employment departments	5

Admission to the Classes

It is expected that at the conclusion of the first course a second will be offered. Present plans call for three courses in succession. Owing to the fact that it is a war emergency course and that the ground must be covered hurriedly, the students are expected to devote all of their time intensively to this work, approximately nine hours daily for six days in each week extending over a period of six weeks. It is proposed to have about 20 men in each course; if 40 men wish to take it, they will be divided into two groups.

The enrollment at the University of Rochester includes experienced employment managers, two representatives of the Bureau of Labor, several men entered by the Emergency Fleet Corporation, and men of practical experience from various factory departments. Class discussions have proved highly interesting and instructive because of the variety of experience contributed by the members. Several prominent employment managers and other experts in related work address the group each week.

Inasmuch as the course is offered at the request of responsible officials in Washington, it is open only to those who have been recommended and nominated by such authorities to pursue this course, subject to assurances that they are fitted for the work and are prepared to render service in this emergency. The selection of men will be made on the basis of previous formal education and practical business experience. Certain definite qualifications will be necessary; these are decided upon only in a general way now. The committee has in mind three main classes to select from: (1) College graduates with not less than three years of industrial experience: (2) persons with high school training, with not less than five years of industrial experience; (3) persons not filling the above qualifications, but by reason of training and experience specially fitted for the work.

The following points are to be taken into consideration in choosing men: Personal characteristics; background of experience; opinions of persons whose judgment can be relied upon. The departments coöperating are agreed that the best type of employment manager will be one who has a sympathetic understanding of the problems affecting the worker, the ability to acquire new ideas, such as a college education is likely to give, and actual experience with factory methods, covering not less than three years of industrial life, in part in actual contact with shop problems.

The most promising source of likely material is the plants in which employment managers are to be placed. The general manager, together with other persons in the plant, will be asked to suggest if possible a man from their own executive personnel—one who in the ordinary course of events would be chosen for the position. Plants already having an employment department, in which the managers are in sympathy with the aims of the committee, are also able to suggest promising candidates. Men in cantonments and other branches of service who are particularly qualified for this work will be detailed from the army to undertake this intensive training. The Adjutant General is coöperating in this matter.

General Supervision of the Courses

It is realized by the Storage Committee that for such an intensive course to succeed, especially where it requires the coöperation of a number of agencies, the general scheme must be kept in mind and the instruction and laboratory work must be supervised by a business man of influence. Mr. Henry T. Noyes, of Art in But-ions, Inc., is giving such supervision in Rochester, and Mr. Howard Coonley, of the Walworth Mfg. Co., is assisting in Boston.

It is hoped that field agents will be later appointed by the Storage Committee to assist in collecting material and in advising instructors. For the present, Captain Fisher is supervising the organization of the courses and will approve the general plans for instruction.

Professors and employment managers who are familiar with the subject will be made responsible for various sections of the course, thus making it a coöperative undertaking. Many of the universities have lost heavily of their best men who have entered government service, thus making it difficult to find professors who have time to devote to new projects. The principal difficulty to be overcome at present is to secure men who have either the practical knowledge or the point of view necessary to give the instruction in employment practice which is to occupy 70 per cent. or over of the entire time.

It would be useless to manufacture material and supplies and pile up the products on the wharves if there are no ships to transport them. So, unless our ship workers do their best, other industries must slow down or halt completely, with the result that thousands of workers throughout the country will suffer for lack of employment.—*Edward N. Hurley.*

Making Up the Labor Shortage

D. N. Crosthwait, Jr.

With C. A. Dunham Company

IT has been said, that "The solution of the conflict between capital and labor awaits the recognition of the law of equal reaction by both stockholders and employees." This law is, "That every act of ours reacts to our advantage or disadvantage according to whether it helps or harms all parties affected."

The present war has brought about a shortage of labor in this country. And while it is necessary that all of the available men of military age and ability be used by the government to the required number, yet the industries must be kept in operation. In fact, in many cases production must be above normal. In the face of such circumstances, it is not surprising that the employer has been at his wits end to supply the labor necessary to produce the required quantity of commodities.

As a means of supplying the necessary labor, we have seen many cases of women supplanting men at various occupations. However, the lure of clerical work, a broadening field now opening up to women, will limit the supply for certain other classes of work. In other cases, too, old men are doing the work of boys. In speaking of the performance of these men it was said: "These men were all from modern industry's discard. They had been unable to keep up the pace, but when they were set at the boy's work, they showed many desirable qualities that the boys had lacked. The firm feels that these old men are well worth the larger compensation which it had to pay to get them." This is attacking the problem of old age insurance from a different angle, and will work out to the mutual advantage of both parties. Despite the above mentioned expedients, for certain classes of unskilled and semi-skilled labor, employers are confronted with labor shortage.

Social Needs and Business Needs

In solving his labor problems the employer, who considers them from all angles, is only exercising the foresight that is essential to future success in the conduct of his business. The old men are a big social problem, and the elimination of the old-age problem is highly desirable from a civic standpoint. And, after all, the solution of most civic problems devolve on the industries of a community. Hence, the advisability of an employer realizing the relationship of civic questions to business. There are other civic problems respecting employment, that employers can now take steps to eliminate while at the same time supplying themselves with steady, reliable employees. When in doing this civic usefulness and *business promotion* are accomplished, a happy medium is reached.

Our Negro Labor Reserve

The employer who can supply himself with faithful, loyal, cheerful and healthy employees to do his unskilled and semi-skilled labor should consider himself fortunate indeed. A field from which to recruit laborers of this class, and one that many employers are coming to appreciate more and more each day, is the negro population of the community. Many employers have recently succeeded in reducing their labor turnover considerably, by the introduction of negro labor. The introduction of this labor can be effected easily, by the simple expedient of keeping the old employees' confidence and at the same time gratifying their desire for gain. This can be done by transferring the present operatives to operations paying a larger rate. As this would mean that they—the old employees—would be transferred to operations requiring more skill, it would result in a saving for the manufacturer, because it would not be necessary to train employees who would be altogether ignorant of the work, ideals and spirit of the organization.

The old employees would not be antagonized since they would be making more money than formerly, and would be doing work that would be more agreeable. In starting this plan, care should be exercised in paying the colored operatives a rate below that formerly paid for their class of work, since paying the new employees less might arouse the idea in the minds of the old employees that it augured ill for them in the future. The exact methods used would, of course, vary for each locality and industry. This is something that can be best judged by the employment manager. It is almost needless to state, that the particular type of work given to this class of labor would need to be given careful consideration. This is attacking the so-called negro problem from a different angle, and will result favorably for the employer and the public at large. By this means, many firms have been able to supply their needs from the community, without importing any labor from afar, and without friction or dissatisfaction on the part of their old employees. Success depends largely upon the tact, judgment and knowledge of human nature possessed by the employment manager.

Colored Men as Mechanics

Colored men have long been used in many foundries as molders, laborers and at other sundry employment, but at present more are being employed than ever before. They have also been used as carpenters, machinists and blacksmiths in small numbers. In fact, the openings in more lucrative lines has in many places caused a shortage of colored labor for purely unskilled work. There are many things that can be done by negro labor in the average manufacturing plant. Among them are:

Punch press operations, drill press operations, semi-automatic machine operations, cleaning castings, chipping and filing castings, rough grinding operations, buffing and polishing articles to be plated, transporting material.

Colored Women in Industry

For the operation of light semi-automatic machines, light punch presses or drill presses colored women can be used to advantage. In the garment making industries and for the weighing and packing of commodities industrial managers would be fortunate in employing them and would get a very desirable type of employee. Married women in many cases would be glad of this employment, since it would give them an opportunity to supplement the earnings of their husbands without making it necessary for them to be away from home during the evening meal hour. Especially would this be so where the working day is eight hours.

Where the work is not of a heavy nature colored women have been employed as janitresses with very satisfactory results. An interesting case where they have been employed at a new task, is by the Yellow Cab Company of Chicago, where they are car washers and renovators. Speaking of the results obtained the night manager says they are 100 per cent. more efficient than men. "They waste no time, they are quick and accurate, and they turn out a clean car every three minutes. The business of car washing has been systematized, each woman washing a particular part. When a car has run the gauntlet, it is clean as a whistle."

In using this new labor, it should be remembered that the department heads and foremen can influence for success or failure. Their attitude will be the attitude of the rank and file. "People will follow a leader," and since the foremen are in direct contact with the workers the service they can render the management must not be overlooked. Prompt discouragement of any incivility or discourtesy by any of the working force will eliminate friction.

No attempt has been made in this article to give a complete resume of the applicability of the negro to the industries. Rather, the effort has been to point out how the management can supply its labor needs without undue trouble and do away with the labor turnover problem. The negro population of most large industrial centers offers a supply of labor of great potentialities.

Women in British Munition Manufacture

IN October, 1917, the factories producing munitions in Great Britain employed 2,022,000 men and 704,000 women. The monthly increase since that time has been at the rate of about 11,000 men and 19,000 women. The total is about two-thirds of all the labor employed in industry on British government work.

In the national factories women workers outnumber of men in the following percentages:

In royal factories, 32; national projectile factories, 47; explosive and propellant factories, 55; national shell factories, 72; and national filling factories, 79 per cent.

As regards explosives and optical glass, not only has Great Britain become self-contained, but she has been able to help her allies, the extent of the chemical output being so great that the weekly production of chemical shells at the end of the year was six times the output at the end of 1916. The situation in regard to the production of small arms and rifle ammunition has become secure; the lorries in possession of the armies increased during the past year by 43 per cent.; the number of cycles, 91 per cent., and cars and ambulances by 73 per cent.

Moreover, great and permanent improvement has been made in reducing the cost of munitions. It is stated by way of example that if "the gun ammunition program of 1917 had been ordered at the prices of 1916 the increase in cost over the actual would have been £43,000,000 ($215,000,000)." This result has been obtained in the face of a continual increase in wages.

The Live Wire Era

By F. H. Bogart

A good deal of the present-day demand for the "live wire" to fill executive positions in our manufacturing industries is based on the mistaken idea that human dynamic force can of itself be made an effectual substitute for either business or mechanical experience and foresight. Men of this type accomplish results—of a certain character—and, fortunately for themselves, accomplish them at just that period in the development of any new undertaking when the men higher up are the most anxious to get action and the most impatient if expected results are not forthcoming. Their method, moreover, will be making a showing when the business or mechanical analyst would be engaged in a detailed study of the basic faults of organization or equipment—a study that is absolutely essential as a groundwork for the method this type of executive must follow to secure what, in his own estimation would constitute a satisfactory result. Work of this character is entirely devoid of fireworks, and during its progress it is practically impossible to make any improvement in conditions that will be apparent above the surface, because to dabble in petty reforms would only complicate and delay the task of constructing a consistent and common-sense organization or production plan from the foundation which the analytical work is to disclose. Men of this type are consequently at the start under the handicap of their own method, and, because they seem to be plodding along without result at a time when an over-anxious official may be expecting spectacular improvements in conditions, they are subject to proddings and criticism that reduce their efficiency and that operate to the disadvantage not only of the individual but of the type, and indirectly boost the prestige of the "live wire" whose quickly-achieved results create a more favorable impression.

It is not my purpose at all by the above to discredit the "live wire" or to even suggest that physical energy and an alert mind are not splendid assets in the accomplishment of any organization or mechanical task. The point I am driving at is that just at the present time many people seem to think that an abundance of "push" is all that is needed to put through an undertaking in the line of creating a business or perfecting mechanical production, while I contend that in the long run the prime essential is experience. Backed by practical experience in the same or similar lines of work, a surplus of physical energy and the ability to hold the keen edge of one's intellect through a long day's work is the finest asset imaginable. Mere executive aggressiveness, on the other hand, not based upon practical experience, in nine cases out of ten becomes a whip on the backs of the subordinates who may have that experience, growing constantly more irritating as greater pressure is brought to bear, until the whole organization is in a state of nerve tension incompatible with good work and reduced to but a small fraction of its normal efficiency.

Editorials and Comment

Make Our Executive and Engineering Power Count for Victory

THIS war is an engineers' war. How often has this statement been made and repeated. Still the fact remains that engineers, technically trained men and industrial executives are not being utilized to win the war as they might be. Our industries are the greatest in the world, we have as creative and constructive brains as any nation on earth, and our men are as patriotic and self-sacrificing as any engaged in the great world struggle; yet we have failed to solve the problem of how to get every industrial executive and engineer into the job for which he is best fitted.

Let us suppose that an executive is required in some government factory, or other governmental service. How is he obtained? Perhaps an advertisement is run in the pages of the technical magazines, or a request is sent to some one of the engineering societies, and finally a man possessing the necessary qualifications is found. This man is needed badly and is ready to go to work. But there is an obstacle that means delay. His assignment must be approved by the United States Civil Service Commission. This is law. It is excellent law provided it is not administered in a hampering manner.

NEEDFUL ACTION

1. Appropriation by Congress of sufficient sums for the use of the United States Civil Service Commission so that that body can register every industrial executive and engineer in the United States.
2. Preparation by the United States Civil Service Commission of an adequate, unified classification that will show the actual qualifications of every industrial executive and engineer in the United States.
3. Registration and classification by the United States Civil Service Commission of every industrial executive and engineer in the United States, with the double purpose of supplying immediately men for the service of the government in all of its manufacturing and technical branches, and of affording information to private employers in regard to men available for their needs.

But practically it does take a considerable length of time to obtain the necessary authorization for the employment of an engineer or executive on government work. The reason lies largely in the fact that the United States Civil Service Commission has not been supplied with the necessary funds so that it could expand its work to meet the tremendous demand upon its services due to the war. It is handling an amount of work perhaps a thousand times greater than it was organized to do. Hundreds of names reach it daily, and every position to be filled must have careful consideration and, of course, must wait its turn.

It is an imperative need that Congress should supply sufficient funds to permit the United States Civil Service Commission to expedite its regular work and carry out a far-reaching constructive program of registration.

To be sure, many agencies have responded to the request to supply the names of men who might fit particular needs of the government. Especially, the technical and engineering societies of the country have furnished names of thousands of their members. Engineering schools have been another source of such information, and many private agencies have helped.

The great keynote today is to centralize and to coördinate work of the same general character, instead of having it done in many places by a number of different agencies.

Applying this principle brings this suggestion: Instead of having the United States Civil Service Commission pass upon the qualifications of an engineer or industrial executive *after* he has been lined up for a particular position, why not have the Commission exercise the greatest function of employment and register the engineering and technical men of the country? Why not have in Washington a great storehouse—if you will—from which men with specialized training and ability can be selected as rapidly as they are needed. Then, when a call comes from any government department for a man for a particular line of work that man can be picked out at once from a possible list, and with the utmost expedition placed at the work where he is needed.

Carrying this same thought a little further, why not throw open these records, this storehouse, to private manufacturers who are in need of skilled men for war industry.

A classification for such a purpose would have to be most carefully and skillfully prepared. The questionnaire would have to be framed to bring out the real merit of a man's education, qualifications, capacity and technical and manufacturing experience. But all this can be done with success. Then, backed by the authority of Congress, the Civil Service Commission could make sure that every man fitting into this classification was duly and adequately registered in its records.

It is stated that before the war Germany had a complete classification of every engineer and man of manufacturing experience in the Empire. The German government knew exactly who each man was, what his qualifications and experiences were, what he was best fitted to do.

We have been a year at war. Volunteer agencies have done what little has been accomplished in making available our industrial and engineering man-power for the work that is to lead on to victory. Is it not time that the government should take over in a unified and coördinated manner this great work of classifying, registering and placing at work our engineers and industrial executives. Some time this work must be done. Why not begin it now?

Convention of Industrial Engineers

A THREE days' national conference was held in Chicago the latter part of March under the auspices of the Society of Industrial Engineers and the Western Efficiency Society. These two organizations planned a discussion of labor problems under war conditions dividing this main subject into four topics: Women in Industry—Replacing Men; Mechanical Equipment—Its Function in Replacing Men; Men Remaining—Securing Their Maximum Production; After the War—Readjustments to Take Care of Those Returning, Including Disabled.

The registration throughout the conference reached a total of about 1100; twenty-one states and Canada were represented, and a gratifying feature was the attendance of a number of women.

The keynote of the conference was presented by Mr. C. E. Knoeppel, and may be expressed by the phrase "coördination of engineers" to win the war and to prepare for the commercial conflict after the war. Very properly he pointed out that to coördinate others we must coördinate ourselves, and it was suggested that this great problem of coördination among industrial engineers should be made the topic for the next national conference of the societies.

INDUSTRIAL MANAGEMENT regrets that it is impossible to present even a synopsis of many of the strong papers that were given at Chicago. Only one is commented upon in this issue. The article on page 385 by Mr. C. E. Knoeppel has been developed from his principal address at the conference.

A Pound of Coal

AMERICAN industry has always had an ample supply of fuel except during the past winter. This continuous surplus has made manufacturers and producers of power regard coal, not from the viewpoint of its capacity to produce power, but from its cost in dollars and cents. But shortage or threatened shortage has brought a change in outlook.

Today a pound of coal is valued for what it will produce, not for what it costs. And with this change in valuation comes a host of considerations in regard to the utilization of coal that before was pushed aside as of minor importance.

When a pound of coal is looked upon from the viewpoint of what it will produce it becomes evident that it must be used with the greatest possible effectiveness. In other words, we must arrange to get every possible advantage from the heat or the power that the coal represents. To do this steam production and power generation must be placed on the highest possible plane of efficiency. Once this viewpoint is taken our horizon extends to take in improved power-plant machinery and apparatus of all kind, the selection of materials and supplies to fit them to particular requirements, organization of all the power-plant work, and the selection and management of all the labor involved. To be sure, these matters have not been completely overlooked before but now they have added significance. Each one presents problems that must be solved properly provided we are to obtain the maximum effect from each pound of coal that potentially represents so-much heat or so-much power.

The situation is far from being unhealthy. It is a case of not recognizing our blessings until we are partially deprived of them. Without doubt the millions of tons of coal that will be burned in the United States in the coming year will be more effectively utilized than any similar amount in the history of American industry. It is not too much to believe that the power-plant machinery, organizations and methods that will be put into use during the coming months will carry over into the times of peace and mean still more in the effectiveness of power production for industry. This is an advantageous by-product of the great war or, more specifically, of our shortage of fuel.

But that the maximum result may be obtained a grave duty rests upon every industrial manager and power-plant engineer to see to it that the work for which he is personally responsible is done with a maximum of effectiveness. Following the expression that heads Mr. Walter N. Polakov's series of articles now running in INDUSTRIAL MANAGEMENT every one having to do with the generation of power must *master its production.*

Our Lack of Firmness

"AS a man thinketh so is he." If there ever was need of firmness, or militant determination on the part of Americans it is today. In the face of this need it is a bit disheartening to find a lack of fixed purpose in the minds of some in regard to the war.

For more than two years after it began we hoped that we would be able to keep out of the struggle, and when we did go in far too many held to a secret wish or hope that a show of our power would be sufficient to bring the end of the conflict in sight, and that we would not have to develop and exert our full military and industrial strength.

That concealed thought has not been entirely rooted out. It still persists as one of the weaking elements in our prosecution of the war.

In the minds of industrial managers and workers it acts to retard and hold back production. Why should any one strain every nerve to get a lot of shells, guns, fuses or other war material finished if one harbors the secret thought that after all these things will not be used. Or what is the use of rushing and hurrying the building of ships if maybe something, somewhere will intervene and quickly bring the end of the war.

These thoughts and this attitude must be as completely rooted out of our industrial life as we would cut away a malignant growth that threatened our physical life, or the life of some of our loved ones. Now is the time for firmness, for iron determination, not for half hearted measures and shilly-shally efforts. Now is the time to realize that the entire power of this great nation must be turned into the struggle; partial efforts will not bring victory. So, pull out by the roots the secret thought that America can do her part by merely making a show, not by forcing things clear through to their ultimate and final conclusion! Remember victory comes to the man who thinks victory, who does not give up during the last fifteen minutes of the struggle!

Engineers De Luxe

CAN we believe our eyes and ears? Can we believe that any one is trying actually to set up an aristocracy of engineers in these days when the whole civilized world is pouring out its blood and treasure for democracy? Can we imagine that engineers, of all people, are endeavoring to get a patent of nobility. Can we imagine that any small group of engineers in this country would lend itself to drawing a charmed circle around 200 of its number, now, when there are so many appeals to patriotism and such a burst of earnest democratic feeling? These thoughts would perish as soon as they flashed into any one's brain, unless they were proved to have a basis of fact.

But here is the proof. A bill (S. 2360) has already passed the Senate of the United States to establish an American Academy of Engineers. Fifty prominent men are to be its incorporators and it cannot have more than 200 members. It is to be self-perpetuating and the body is to have the power to fill all vacancies in its own communion.

The bill is now before the House of Representatives (H. R. 4625) and has been referred to the Judiciary Committee.

But it is very evident that the bill as framed is incomplete. No provision is made for the title of nobility with which the members of the *de luxe* circle are to be addressed. Perhaps it may be suggested that, My Lord Engineer So-and-So might serve. Furthermore, the bill fails to provide for hatchments or escutcheon or other form of armorial shield to be displayed and worn by the nobles of the engineers. But it is possible that these are merely minor points that will work themselves out should the bill become law.

Something like 150 years ago, the great leaders of democracy who founded this nation destroyed, as they thought, the possibility of establishing an aristocracy in this liberty-loving land. Their work, their example, indeed their spirits reaching out to us from the past, inspire us to work with our full measure of strength for true democracy. And in these days of stress when that work means throwing ourselves into the greatest war of all history, where the real issue is whether democracy shall live or die, there comes this attempt to grant a patent of nobility to a few engineers. A perusal of the bill gives the decided impression that the purpose behind it is not patriotic but ambitious, that it is undemocratic and un-American.

An aristocracy of engineers; a *de luxe* section of the engineering profession! It is to smile, and then to laugh!

Another attempt is being made to attack the well known, production hindering, "anti-efficiency" riders of the appropriations for the support of our military establishment in this time of war. Every patriotic citizen should immediately and emphatically direct the attention of his representatives in Congress to this proposal.

Factory Equipment News

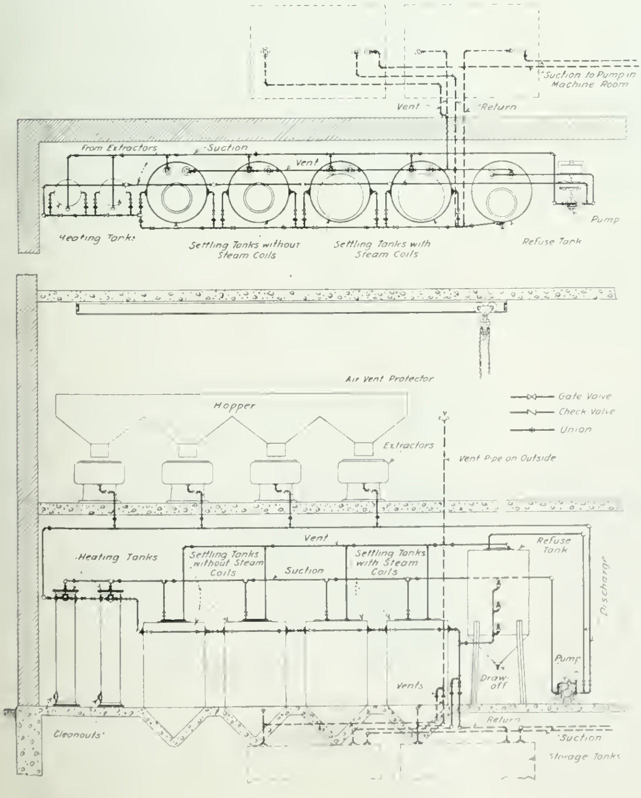
The Latest Labor-Saving Machinery

Bowser Cutting Oil Reclaiming System

A Bowser oil reclaiming system, as installed by the S. F. Bowser Company, Fort Wayne, Indiana, consists of the following units shown in the accompanying illustration: Two heating tanks, four cone-bottomed settling tanks, one cone-bottomed refuse tank, one cylindrical tank for the storage of new and reclaimed oil (in some cases two tanks), one power pump for handling the oil throughout the system.

While the standard system consists of the number of units shown and enumerated, special conditions may, of course, call for a different number or arrangement.

The capacities of the cone-bottomed tanks, the refuse tank and the cylindrical storage tanks vary to meet operating conditions, while the capacities of the heating tanks remain the same for all ordinary operating conditions. The data showing the capacities of systems designed to handle from 100 to 2000 gallons in 24 hours and indicating the sizes of the tanks are not given here for lack of space.



GENERAL ARRANGEMENT—BOWSER CUTTING OIL RECLAIMING SYSTEM

The operation of the system is as follows:

The oil from the centrifugal extractors, in which separation of oil from metal chips is accomplished, enters the first of the two heating tanks from a flange at the top of the tank and flows downward through an interior pipe line to the bottom of the tank. It overflows from the top of the same tank at a point nearly opposite that of entrance into the second heating tank, which is identical with the first, and through the overflow from the second tank the oil flows into the first of the settling tanks. The functions of the two heating tanks are: First, to render the oil more fluid by raising its temperature, thus facilitating precipitation. This operation is accomplished by means of a spiral heating coil within each tank. Second, to sterilize the oil when desired.

The oil enters the first of the series of the settling tanks and flows downward through an interior pipe line to a point at a level with the top of the cones. It overflows into the next settling tank at a point opposite that of entrance, and so on through the series of settling tanks. The general piping arrangement of ingress and egress of oil is similar for the heating tanks and settling tanks.

It will thus be seen that the oil passes through the cone-bottomed settling tanks in series, i. e., the oil passes through each tank, precipitation of impurities taking place during the entire process. The last two tanks in the series are supplied with steam coils to aid further in the process of precipitation, and, like the steam coils in the heating tanks, may also be used for the purpose of further sterilizing the oil.

Each of the settling tanks is provided with a large cap-bolted manhole to facilitate cleaning or inspection, while the heating tanks are provided with a clean-out opening at the bottom of each tank.

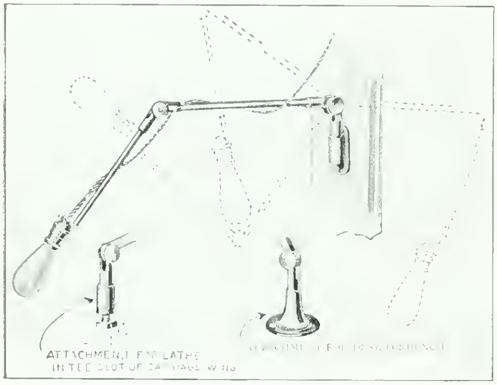
By means of the rotary pump, the oil may be transferred from the bottom of any one of the settling tanks to the refuse tank. The suction line in each settling tank reaches very nearly to the bottom of the cone, so that the heavy sediment which has accumulated during the settling process may be withdrawn into the refuse tank, where further precipitation takes place, the final worthless deposit being drawn off from a cock at the vertex of the cone bottom. On the side of the refuse tank will be noted a series of sampling valves communicating with a pipe line which returns the clarified oil to one of the two storage tanks. It is the usual practice to use one of the two storage tanks for reclaimed oil, while the other is reserved for strictly new oil. It will be noted, however, that the piping is so arranged that the reclaimed oil can be returned to either tank.

The sampling valves permit a very small quantity of oil to be withdrawn, the sample showing the extent to which precipitation has taken place at the level of the valve. If sediment is still found in the sample, the valve is closed and further time allowed for precipitation. If the oil is found to be clarified, the entire supply in the refuse tank, down to the level of the sampling valve used, is allowed to return to the storage tank. The process is repeated with the other two sampling valves, the operation, of course, being governed by the amount of oil in the refuse tank.

It is quite usual to place the cylindrical tanks for the storage of reclaimed and new oil underground, though in such an event, care should be taken to insure proper temperature conditions by the installation of a steam coil in each tank, or tanks may be installed in a pit or basement which is suitably walled.

"Spotlight" Lighting Fixtures

A COMPLETE line of brackets and fixtures for electric lights for factory use is manufactured by the Newman Manufacturing Company, Cincinnati, Ohio. The illustration gives an idea of the general features of construction. The bracket has a base made in various forms to suit different conditions, and can be attached to wall, ceiling, post or some part of a machine. Movable joints permit of shifting the arms of the bracket and, thereby, the position of the light to whatever location is desired. A slight push or pull adjusts the light and the adjustable friction joints hold it in the new position.

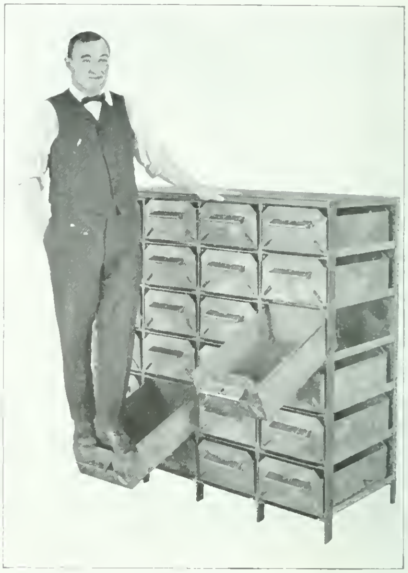


THE "SPOTLIGHT" LIGHTING FIXTURES

One type of bracket, besides being adjustable to any spot within a six-foot radius, telescopes either upward or downward a distance of three feet.

New Britain Tote Box Rack

A TOTE box rack designed to facilitate the storing of small parts has been developed by the New Britain Machine Company, New Britain, Connecticut. As shown in the illustration, the front uprights are of flat steel; those at the rear are angles. The angle runners upon which the boxes slide are electrically welded to each pair of uprights. These welded members are connected by cross ties at the front, the back being closed in and stiffened by sheets bolted to the angle uprights.



NEW BRITAIN MACHINE CO. TOTE BOX RACK

These racks are commonly furnished in standard units. They may, however, be expanded horizontally to any extent and may be built to accommodate a greater number of boxes in each tier. Units are frequently placed back to back with a common sheet metal division between them. Attention is called to the feature whereby the box when hauled out is permitted to sag slightly, for the raised gear and comes in contact with the front cross tie. In this position the interior of the box is exposed, permitting easy loading or unloading.

The following specifications cover racks for two sizes of standard boxes:

Size of box accommodated	16" x 10" x 5"	20" x 12" x 6"
Overall height of one six-box section	3' 11"	13⅛"
Overall width of one six-box section	11⅞"	4' 5"
Overall depth of rack front to back	18"	22¾"
Height between floor and lower box	4"	4"
Height of box space	7"	8"
Width of box space	10⅞"	12⅞"
Weight of one six-box section complete	63 pounds	52 pounds

The Factory Lunchroom and Equipment

FOR a long time the spread of the factory lunchroom idea was retarded because of the taint of "welfare." Employees looked upon it as paternalistic. The employers did not sift the practical from the sociological.

But to-day a group of hard-headed business reasons are recognized behind the idea of properly equipped and efficiently operated industrial restaurants and lunchrooms. It has been proved repeatedly that they confer great benefits upon the employee. And whatever benefits the worker benefits the management likewise.

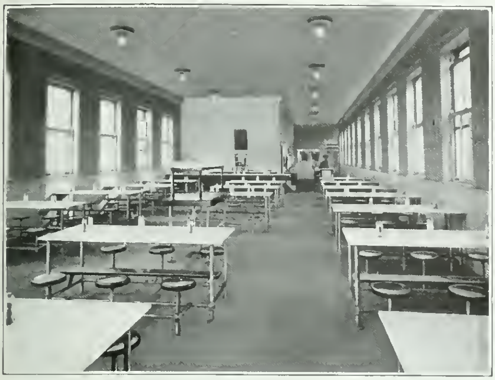


FIG. 1.—DINING ROOM OF WISCONSIN STEEL COMPANY

Both must see that if a certain thing benefits the health and well-being of the employees—although for different reasons—that thing must be adequately supported.

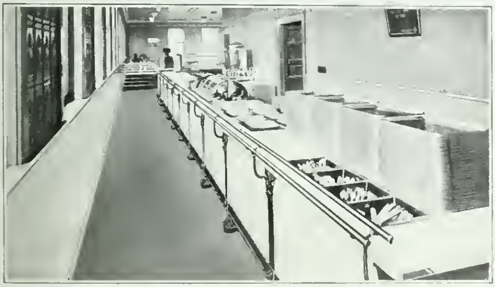


FIG. 2.—SERVICE COUNTER OF WISCONSIN STEEL COMPANY

One advantage that has come from the industrial lunchroom is the growth of the science of modern dietetics. Have you ever stopped to think that people use more sense to-day in eating than they did 20 or even 10 years ago? People are gradually learning that much illness and discomfort comes from improper eating. Again, a person may be undernourished because he does not eat enough of certain things. The diet may be right in quantity and of wholesome dishes, but deficient in quality and variety.

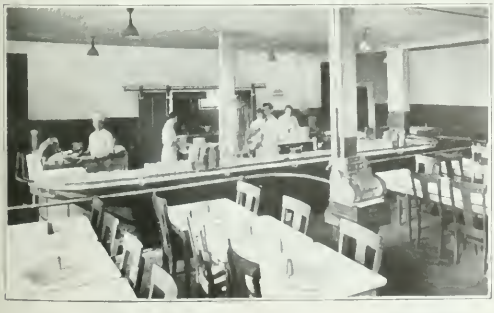


FIG. 3.—LUNCHROOM OF OHIO MALLEABLE STEEL COMPANY

It has been proved that proper food eaten under proper circumstances in the middle of the day results in better work. Imagine the case of a shop girl who rises from a good night's sleep thoroughly refreshed and rested, but lacking in time for dressing and eating, and so hurries away to work without breakfast. Unless she is unusually strong and healthy, her day is likely to be spoiled. About 10 o'clock she may not feel hungry, but she is tired. She has been drawing upon her reserve energy. In the middle of the afternoon she may develop a headache. The net result of all this is that she has accomplished comparatively little during the day, all because of improper and insufficient nourishment.

Good Food Reduces Accidents

The management of a certain factory noted that the greatest percentage of accidents occurred in the hour immediately following the noon luncheon period. More casualties were crowded in that 60 minutes than into the rest of the day. An investigation showed that many of the workmen went to a nearby saloon to lunch or had beer brought into the factory during the lunch hour. A stringent order was issued barring beer, and milk was supplied free to any one who wanted it. As a result the number of accidents occurring immediately after the luncheon hour was reduced almost to zero.

Dietetic experts tell us that food eaten under pleasant circumstances and agreeable surroundings does more physical good than under other conditions. The factory lunchroom is the pleasantest place in the shop or its surroundings where employees can eat.

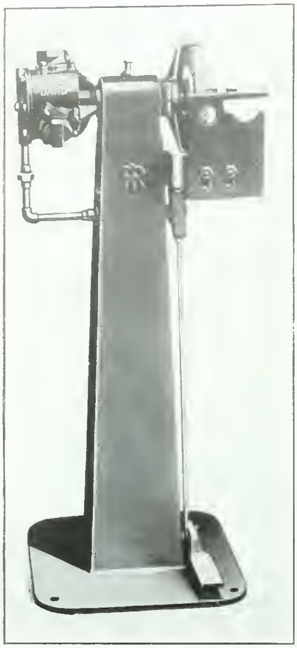
Under ideal circumstances the tables are spotlessly clean. The walls and ceiling are pleasantly decorated and the floor is immaculate. Everything is sanitary and the equipment is pleasing in appearance. The food is of the best, and adapted to the requirements of the employees' condition and work. A girl doing sedentary work cannot feel as well during the afternoon if her inside mechanism is wrestling with meat and other heavy foods; but a bowl of soup and a sandwich, with a cup of chocolate or milk with a dessert, furnishes the necessary nourishment.

Whether a lunchroom pays or is run at a loss depends largely upon the mode of operation. The latter must be carefully planned and properly conducted. It is a restaurant and should be conducted on restaurant principles. An expert man or woman should be placed in charge; it should not be entrusted to the tender mercies of novices and theorists. The food should be purchased in quantities. A careful check up system must be provided, the dishes served must be in variety. Each item should be charged for separately, so if a person wishes to go without butter, or get along with one piece of bread, the amount of his check will be in accordance.

Turning now to the matter of equipment, this can be had in a variety and form suited to every need. The Wisconsin Steel Company has an attractive dining room shown in Figure 1, with an extensive service counter shown in Figure 2. The equipment was installed by Albert Pick & Company, Chicago, Illinois. The front panels on the counter are vitrolite, and the top of glass, the pilasters and molding are of malleable iron finished with baked enamel.

Figure 3 shows the lunchroom of the Ohio Malleable Steel Company, Columbus, O., which is especially arranged for quick service.

Air-Driven Pedestal Grinder

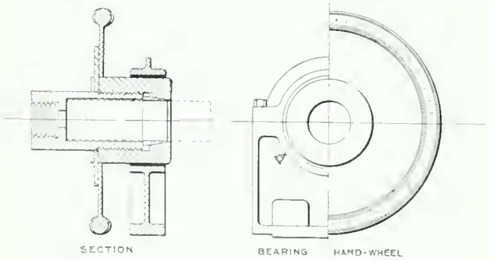


"LITTLE DAVID" INGERSOLL-RAND GRINDER

FOR general service, where a stationary air-driven grinder is preferable to one of a portable type, The Ingersoll-Rand Company, New York, N. Y., is placing on the market the machine illustrated herewith. It is designated as a No. 8 "Little David" grinder. The three-cylinder motor, with its continuous power impulse, the rotary valve integral with the crankshaft, and the triple ball bearing spindle are of similar design to the same manufacturers' No. 7 "Little David" grinder. The machine is rated to operate at 3400 r.p.m. with compressed air at 80 pounds pressure. Control is effected by means of a convenient foot lever. The grinding wheel usually employed is 10 inches in diameter and one inch face, though other sized wheels may be used.

Campbell Shell Chucks

THE illustration shows a turning chuck which was originally developed for shells, but can be adapted to use on disks, plugs, bars and the like. For shells the front end of this chuck runs in a babbitted bearing to give a maximum of rigidity. Opening and closing is accomplished with one stroke of the handwheel placed just above the bearing.

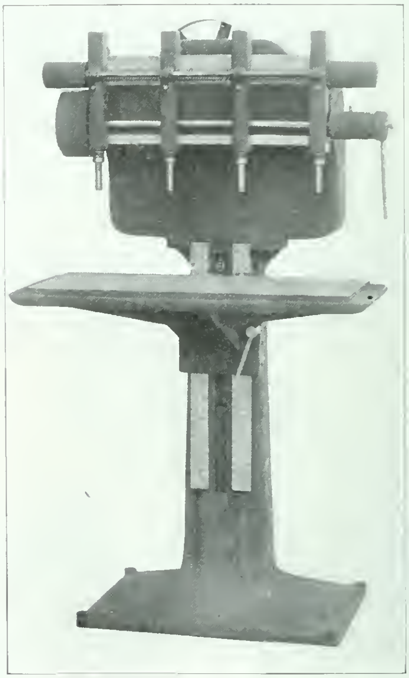


CAMPBELL SHELL CHUCK

In the smaller size the operator handles the chuck automatically closing by momentum as the lathe starts, and opening by the same force as it stops. The collet is long and grips for its entire length. There are three moving parts, the collet, the sleeve and the hand-wheel. This chuck is manufactured by A. M. Campbell, Brockville, Ontario, Canada.

Valve Grinding Machine

THE Defiance Machine Works, Defiance, Ohio, has recently placed on the market a machine designed to grind all the valve seats in a cylinder block at one time. Simple adjustments of the spindles offer a wide range, thus permitting the reaching of varying centers. The machine can also be furnished with special heads to grind the seats of any cylinder fitted with staggered types of valves.



DEFIANCE VALVE GRINDING MACHINE

The head which carries the spindle is rigidly constructed and all the running parts are enclosed and packed in grease. The oscillating motion for the spindles is transmitted to the driving rack by means of a sliding rod and spur gear. The up and down movement is automatic at regular intervals, to permit the spreading of oil and emery over the grinding surfaces.

The table is vertically adjustable, counterweighed and designed to insure rigidity. The column is of a box section.

The regular equipment includes the countershaft and pulleys.

The minimum center to center of spindles 1⅝ inches; maximum distance between outside spindles 22 inches; distance, face of upright to center of spindles 7 inches; size of table working surface 14 x 32 inches; oscillating movement of spindles 1¼ revolution; automatic up and down movement of spindles every 10 revolutions.

The "Ardee" Gravity Conveyor

THE "Ardee" gravity conveyor consists of a series of rollers assembled in rigid steel frames in 8-foot lengths, which, when placed at a slight grade, will carry merchandise in any direction. The frames are portable and require no skilled labor to put them up or take them down. Short lengths can be used as a conveyor or skid from shipping platform to the tail board of a truck. Longer sections running to thousands of feet are adapted for conveying material, product and supplies around industrial plants.

The frame of the conveyor is made of structural steel trussed to insure its stiffness. Each roller revolves in case-hardened steel roller bearings housed in a manner to protect them from dust. Frames or units of the conveyor are joined together by an interlocking coupler fastened at the sides. The hooks of one end interlock with two flanged bolts on the adjoining unit. Sections can be added indefinitely until the required distance is covered.

GENERAL VIEW OF "ARDEE" GRAVITY CONVEYOR

A feature of the construction is the bearings of the rollers. These are roller bearings provided with strong steel thimbles to avoid any dislocation of the rollers. The illustration shows a section of the Ardee gravity conveyor being used in connection with an unloading machine on shipboard. This conveyor is manufactured by Rownson, Drew & Clydesdale, Inc., New York, N. Y.

Fleming Combination Lathe

A UNIVERSAL machine tool combining in one the facilities of three machines, namely, a 16-inch engine lathe, a horizontal boring mill, and a plain milling machine, has recently been put upon the market by the Geo. W. Fleming Company, Springfield, Massachusetts, under the name "Combination Lathe Boring and Milling Machine." An additional feature is that of a sliding bed gap lathe, as shown by the second of the two accompanying illustrations.

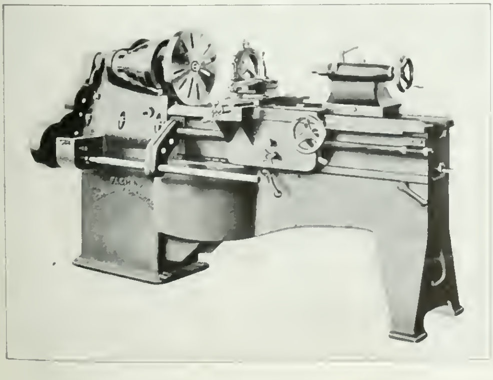


FIG. 1.—FLEMING COMBINATION LATHE

These views indicate the general features of construction so clearly that a detailed description is unnecessary. In Figure 1 we see the machine arranged as an engine lathe with the gap closed. The milling machine table acts as support for the sliding bed when the latter is closed. The combination rest can be used up to a full swing of 25 inches when the gap is opened.

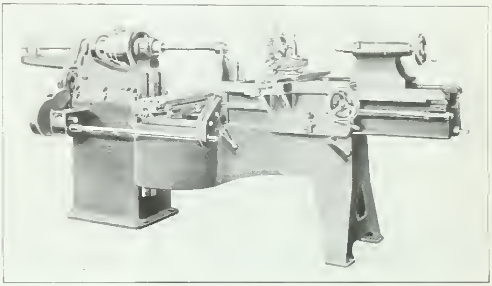


FIG. 2.—FLEMING COMBINATION LATHE

The headstock has a four-step cone pulley and a single back gear. The spindle is hollow, and means are provided for taking up wear both laterally and radially.

The milling machine table, saddle and knee are best seen in Figure 2. The table is elevated on the face of column by means of helical gears and a screw. The crank for operating this movement is in a convenient location on the face of the column. The milling machine table is equipped with hand feed.

When used as a boring mill the machine is of the platen and table type using a boring bar 1½ inches in diameter. It is provided with power feed, deriving its motion from the lathe change gears.

Following are the major specifications:

With bed closed, the distance between lathe centers is 36 inches; with bed open, 57½ inches. The lathe swings over the ways 17¼ inches; over carriage, 9 inches; in gap, 32 inches. The milling machine table has a longitudinal feed of 20 inches; vertical feed, 15 inches; cross feed, 7½ inches. The milling machine table is 32¾ x 8 inches. The lathe spindle taper is No. 4 Morse; the milling spindle taper is No. 12 Brown & Sharpe.

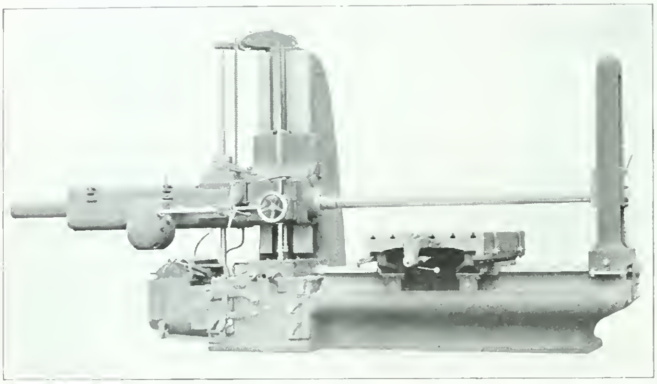
Horizontal Boring, Milling, Drilling and Tapping Machine

THE accompanying illustration and specifications cover a No. 6 horizontal boring, milling, drilling and tapping machine recently placed on the market by the Defiance Machine Works, Defiance, Ohio.

The bed is of box construction, cross ribbed, and so constructed that the machine is entirely self-contained, resting upon a three-point support. The column is likewise of a box section flaring out at the bottom to enlarge the bearing surface where it is bolted to the bed. The spindle is of hammered high carbon steel, ground throughout its entire length to slide through the spindle sleeve. This sleeve is a solid high carbon steel forging with adjustable taper sleeve at the front revolving in a solid bronze box. It has an adjustable taper sleeve at the rear, likewise revolving in a bronze box. This construction is arranged to take up lost motion and permits large milling cutters to be bolted direct to the large flange on the spindle sleeve.

The spindle head has a liberal bearing on the column; the dovetail with taper gib is placed in the center with the actuating screw between. The two sides have a clearance between the column with straps at the back. A gib on the front is set up for the free sliding fit, but assists in taking up any undue strain on the head. A binder screw back of the gib locks the head to the column.

The spindle head and tail block are raised and lowered together, being connected by a shaft and cut bevel gears. The tail block has long V bearings. The spindle drive is through helical cut gears. The reversing is done through a clutch operated by a lever convenient to the operator.


DEFIANCE BORING, MILLING, DRILLING AND TAPPING MACHINE

The platen is provided with deep T slots and is gibbed to the saddle by a square lock and binder screw clamps.

Feeds are applied to the spindle in or out of the spindle head, to the saddle up or down along the bed, and to the platen crosswise of the saddle. Two levers operate the shift with two sets of cone gears, four in one set and three in the other. These give twelve changes of feed per revolution of the spindle. Another lever with a convenient indexing device sets the spindle head, platen or saddle movement giving the same feed wherever applied. A safety friction in the feed box yields before any of the mechanism can be damaged. Fast travel to all parts having feed is obtained by a lever in a convenient position.

Hand adjustments are provided for the movement of the spindle head, saddle and platen. The adjusting screws are provided with dials graduated to 0.001 inch to facilitate the production of accurate work.

The spindle speeds are obtained by means of two cones of five hardened gears each, running idle except when one set is meshed by a roll-in hardened gear operated by a lever at the side of the machine.

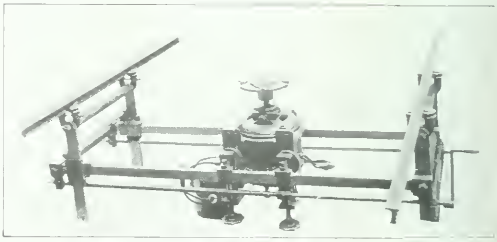
The general specifications of the machine are:

Diameter of spindle	4½ inches
Morse taper hole in spindle	No. 6
Traverse of spindle	(2 x 30 in.) 60 in.
Maximum distance face plate to back rest	7 feet
Maximum distance top of platen to center of spindle	37 inches
Maximum distance top of head to center of spindle	47½ inches
Size of platen	36 x 64 inches
Cross feed of platen	64 inches
Number of speed changes	10
Range of speed	7½-157 r.p.m.
Number of feed changes	12
Range of feed, inches per revolution	0.004 to 0.5
Diameter of driving pulley	18 x 5¼ inches
Width of belt	5 inches
Speed of pulley	300 r.p.m.
Weight	26,000 pounds

Electrically Driven Surfacing Machine

GRAY & BARASH, INC., Seattle, Washington, has recently placed on the market an electrically operated machine for adzing the uneven surfaces of bottoms and deck beams of wooden ships preparatory to planking. It might be called an electric "dubbin" machine.

The knives are carried in the cutter-head mounted on the shaft of an alternating current motor running at a speed of 3,600 revolutions per minute. The motor, by means of ball and socket joints, has a three-point suspension mounted upon two bars, which in direction are transverse to the travel during the operation of dressing. These transverse bars are supported at the ends, at one extremity of which are grooved wheels running on annular ball-bearings. These ride on the bed or a standard "T" rail, two of which form a trackway for the machine. The rails are secured to the surface to be dressed through some convenient means, as by lag screws. The rails are light enough so that they can be formed to the molded shape of the surface to be dressed, and thereby determine the contour of the finished surface. The rough adjustment of the machine is made through a rack and pinion arrangement on the supporting arms. The final adjustment of the cutter-head, both as to elevation and angular position, is secured through screws working through the three ball and socket joints referred to above. The movement along the transverse bars is secured by two lead screws manipulated through a removable crank.


ELECTRICALLY DRIVEN SURFACING MACHINE

Gearless Drilling Heads

IN the accompanying illustrations are shown the gearless type of multiple-spindle drilling heads manufactured by the Heinkel Machine Tool Company, Sandusky, Ohio. Figure 1, shows two views of a four-spindle adjustable head. Adjustment as to center distance can be made while the machine is running, thus adding to the convenience of the operator in locating drills in jig bushings. A feature of this head is the elimination of overhang on one side of the drill press spindle, as the method of adjustment allows the drills to be equally balanced across the center line of the spindle.

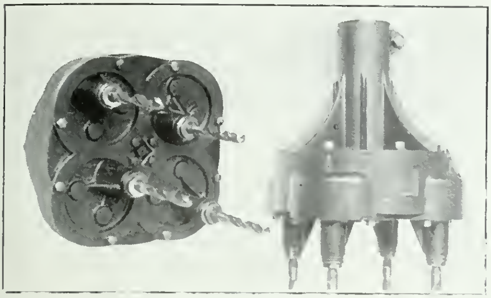


FIG. I.—HEINKEL FOUR-SPINDLE DRILLING HEAD

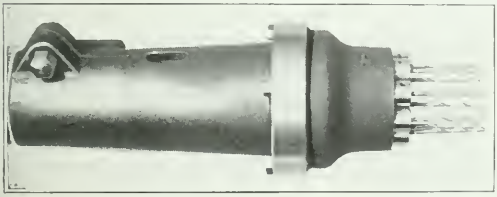


FIG. 2.—EIGHT-SPINDLE HEAD—FIXED CENTER TYPE

Figure 2 shows an eight-spindle drilling head of the fixed center type. The head is fastened to the sleeve or quill of the drill press by a clamp screw and is held from slipping upward under the pressure of drilling by a stop which abuts against the bottom of the drill press rack.

An annular drill bearing mounted on the taper shank gives an extra support to the head and the drill press spindle. The drive is taken through the hardened and ground taper shank, which has a crank on the lower end. An annular ball bearing is mounted on this crank, and to this in turn is attached a driving plate which oscillates when the taper shank revolves. In the driving plate are inserted the hardened and ground cranks of the drilling spindles. The driving plate has no thrust whatever. A ball thrust bearing is mounted on each spindle. The oscillating motion of the driving plate causes the drilling spindles to revolve as motion is transmitted by the rotation of the cranks.

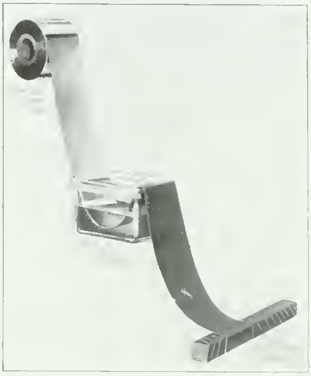
The head is oil tight and entirely enclosed. The interior chamber is packed with grease and requires only occasional refilling. Lubrication is automatic.

All working parts are made of steel hardened and ground throughout.

"John Crane" Metallic Packing

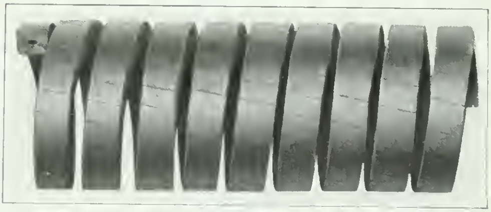
THE accompanying illustrations show specimens of "John Crane" flexible metallic packing and the general method by which this is made.

Continuous ribbons of babbitt metal are passed through a bath of lubricant, and then spirally wound into strips or rods. The result is a packing that can be cut with a knife and will take any form or shape under pressure of a gland, can be bent around a plunger easily, and a packing in which the various layers are separated each from those adjacent by a film of lubricant.



HOW CRANE PACKING IS MADE

This packing is made in straight lengths, rings and coils, for various kinds of service. It is manufactured by the Crane Packing Co., 29 South Clinton Street, Chicago, Illinois.



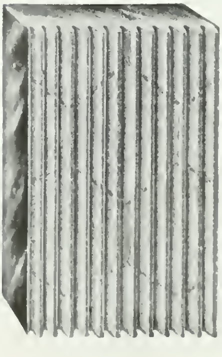
CRANE PISTON ROD PACKING

Aqueduct Glass

TO overcome dripping of condensation from the underside of skylights, the Pennsylvania Wire Glass Company, Philadelphia, Pennsylvania, is now manufacturing a specially ribbed glass under the trade name of "Aqueduct." The illustration shows how the ribs are formed to take advantage of capillary attraction and hold the water formed by condensation and lead it off to proper receptacles.

It is claimed that these ribs in the under side of the glass aid in diffusing light and add considerably to the mechanical strength of the glass itself.

It is particularly adapted to situations where goods might be damaged by drip from above.



AQUEDUCT GLASS

EXPLANATORY NOTE—THE ENGINEERING INDEX

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cents. A denotes a price of 40 cents; B, 60 cents; C, 80 cents; D, $1.00; E, $1.20; F, $1.60. The letter N indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

Serial publications are indexed on the appearance of the first installment.

CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of INDUSTRIAL MANAGEMENT at 10 cents per month, or $1.00 a year; to non-subscribers, 25 cents per month, or $3.00 a year.

REFERENCE LIST OF PUBLICATIONS REGULARLY REVIEWED AND INDEXED

ARRANGED IN ORDER OF THEIR ABBREVIATIONS

A A Wkly	Aerial Age Weekly
AERA	AERA
Aeronts	Aeronautics
A I C E	Amer. Institute of Chemical Engineers
A I E E	Amer. Institute of Electrical Engineers
A I M E	Amer. Institute of Mining Engineers
A I Mt	Amer. Institute of Metals
Am Ec Rev	Amer. Economic Review
Am El-Chem Soc	Amer. Electro-Chemical Society
Am Fdymns Assn	Amer. Foundrymen's Association
Am Ir & Stl Inst	Amer. Iron & Steel Institute
Am Jl Pub Hh	Amer. Journal of Public Health
Am Jl Sci	Amer. Journal of Science
Am Mach	Amer. Machinist
Am Rd Blds Assn	Amer. Road Builders' Association
Am Ry Bdge & Bldg Assn	Amer. Railway Bridge & Building Association
Am Soc Ht & Vt Engrs	Amer. Society of Heat. & Vent. Engrs.
Am Soc Mar Dftn	Amer. Society of Marine Draftsmen
Am Soc Nav Engrs	Amer. Society of Naval Engineers
Am Soc Ref Engrs	Amer. Society of Refrig. Engineers
Am Soc Tes Mat	Amer. Society of Testing Materials
Am Wd Pres Assn	Amer. Wood Preserv. Association
Am Wr Wks Assn	Amer. Water Works Association
A R E A	Amer. Railway Engineering Association
A R M M A	Amer. Raliway Mas. Mech. Assn.
Arch For	Architectural Forum
Arch Rec	Architectural Record
A S C E	Amer. Society of Civil Engineers
A S M E	Amer. Society of Mechanical Engineers
Assn Eng Soc	Association of Engineering Societies
Assn I S E E	Association of Iron & Steel Elec. Engrs.
Aus Min Stan	Australian Mining Standard
Auto	Automobile
Autocar	Autocar
Bkn Engs Cb	Brooklyn Engineers' Club
Bos Soc C E	Boston Society of Civil Engineers
Br Rds & Sts	Better Roads and Streets
Brs Wld	Brass World
Bt Fe & Stl Pt	Blast Furnace & Steel Plant
Can Engr	Canadian Engineer
Can Min Jl	Canadian Mining Journal
Can Soc C. E.	Canadian Society of Civil Engineers
Cas Eng Mthly	Cassier's Engineering Monthly
Cen Ry Cb	Central Railway Club
Chem Eng & Min Rev	Chemical Engineering and Mining Review
C E Soc St P	Civil Engineers Society of St. Paul
Cl Age	Coal Age
Colly Gdn	Colliery Guardian
Col Sl Min Mag	Colorado School of Mines Magazine
Col Univ Qly	Columbia University Quarterly
Com Air Mag	Compressed Air Magazine
Com Vhle	Commercial Vehicle
Comwb Engr	Commonwealth Engineer
Concte	Concrete
Contg	Contracting
Contr	Contractor
Corn C E	Cornell Civil Engineer
Cr Min West Aust	Chamber of Mines of West Australia
E Cb Balt	Engineers' Club of Baltimore
E Cb Phila	Engineers' Club of Philadelphia
E Cb St L	Engineers' Club of St. Louis
Econ Geol	Economic Geology
Eff Soc Jl	Efficiency Society Journal
Elec Jl	Electric Journal
Elec'n	Electrician
Elec Rev	Electrical Review
Elec Rev Chi	Electrical Review, Chicago
Elec Ry Jl	Electric Railway Journal
Elec Wld	Electrical World
Eng & Con	Engineering and Contracting
Eng & Min Jl	Engineering and Mining Journal
Eng Ed	Engineering Education
Eng News Rec	Engineering News-Record
Engng	Engineering
Engr	Engineer
Eng Rv	Engineering Review
Engr Soc Penn	Engineers Society of Pennsylvania
Fkn Inst Jl	Franklin Institute Journal
Flying	Flying
Fndry	Foundry
Gen Elec Rev	General Electric Review
Ht & Vtg Mag	Heating and Ventilating Magazine
Ice & Refrig	Ice & Refrigeration
Ill Eng Soc	Illuminating Engineering Society
Imp Inst Bul	Bulletin of the Imperial Institute
Ind Man	Industrial Management
InstAut Engrs	Institute of Automobile Engineers
Inst Rad Engrs	Institute of Radio Engineers
Inst San Engrs	Institute of Sanitary Engineers
Instn C E	Institution of Civil Engineers
Instn E E	Institution of Electrical Engineers
Instn E & S Scot	Inst. of Engrs. & Shpbldrs. of Scot.
Instn Mun & Cnty Engrs	Inst. of Munic. & County Engrs.
Instn Mech Engrs	Institution of Mechanical Engineers
Inst Met	Journal of the Institute of Metals
Instn Min Engrs	Institution of Mining Engineers
Instn Min & Met	Institution of Mining & Metallurgy
Int Mar Eng	International Marine Engineering
Iron Age	Iron Age
Ir & Cl Trds Rev	Iron & Coal Trades Review
Iron Trd Rev	Iron Trade Review
Jl Actcy	Journal of Accountancy
Jl Geol	Journal of Geology
Jl Ind & Eng Chem	Journal of Indust. & Eng. Chemistry
La Eng Soc	Louisiana Engineering Society
La Nat	La Nature
L S Min Inst	Lake Superior Mining Institute
Machy	Machinery
Manr Assn Engs	Manchester Assn. of Engineers
Mfrs Rec	Manufacturers' Record
Mar Eng & Nav Arch	Marine Engineer & Naval Architect
Mar Rev	Marine Review
Mas Boil Mkrs Assn	Master Boiler Makers' Association
M C B A	Master Car Builders' Association
Mech Eng	Mechanical Engineering
Mech Wld	Mechanical World
Met & Chem Eng	Metallurgical & Chemical Engineering
Min Mag	Mining Magazine
Min & Met Soc Am	Mining & Metallurgical Soc. of Amer.
Min & Sci Pr	Mining & Scientific Press
Mun Eng	Municipal Engineering
Mun Engrs Jl	Municipal Engineers' Journal
Mun Jl	Municipal Journal
Nat Assn Corp Schls	National Assn. of Corporation Schools
Nat Engr	National Engineer
Nat Lime Mfrs Assn	National Lime Manufacturers' Association
Nature	Nature
N E C Instn	N-E Coast Institution
N E Rd Ch	New England Railroad Club
N E Wr Wks Assn	New England Water Works Assn.
N Y Dept Labor	New York State Dept. of Labor
N Y Rd Cb	New York Railroad Club
Per-Way Instn	Permanent-Way Institution
Phil Jl Sci	Philippine Journal of Science
Power	Power
Pwr Pt Eng	Power Plant Engineering
Prof Mem	Professional Memoirs
Quarry	Quarry
Roy Un Ser Instn	Royal United Service Institution
Ry Age Gaz	Railway Age Gazette
Ry Cb Pitts	Railway Club of Pittsburgh
Ry Engr	Railway Engineer
Ry Gaz	Railway Gazette
Ry & Loco Eng	Railway & Locomotive Engineering
Ry Mech Engr	Railway Mechanical Engineer
Ry Rev	Railway Review
Ry Sig Engr	Railway Signal Engineer
S A E	Society of Automobile Engineers
Schl Min Qly	School of Mines Quarterly
Sfty Eng	Safety Engineering
Sib Jl Eng	Sibley Journal of Engineering
So Af Inst Engrs	South African Instn. of Engineers
Soc Nav Arch & Mar Engr	Society of Naval Arch. & Mar. Engrs.
Soc Pro Sci Man	Soc. to Promote Sci. of Management
S & S W Ry Cb	Southern & Southwestern Railway Club
St L Ry Cb	St. Louis Railway Club
Stev Indic	Stevens Indicator
Stl & Iron	Steel & Iron
Surv'r	Surveyor & Municip. & County Engr.
Tel Engr	Telephone Engineer
Telephony	Telephony
Times Eng Supp	Times Engineering Supplement
Tmwy & Ry Wld	Tramway & Railway World
Univ Col Jl Eng	Univ. Colo. Journal of Engineering
Univ Ill	University of Illinois
Univ Kan	University of Kansas
Univ Minn	University of Minnesota
Univ Mo	University of Missouri
U S Bur Mines	U. S. Bureau of Mines
U S Bur Stds	U. S. Bureau of Standards
U S Dept Ag	U. S. Dept. of Agriculture
U S Geol Surv	U. S. Geological Survey
U S Nat Inst	U. S. Naval Institute
West Eng	Western Engineering
West Ry Cb	Western Railway Club
West Scot I & S Inst	West. Scotland Iron & Steel Inst.
West Soc Engrs	Western Society of Engineers
Wis Engr	Wisconsin Engineer
Worc Poly Inst Jl	Worcester Polytechnic Inst. Journal

The Engineering Index

The following pages form a *descriptive* index to the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world in the English, French, Dutch, Italian and Spanish languages, as far as possible on account of war.

The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us. See the Explanatory Note given on the opposite page, where also the full titles of the principal journals indexed are given. This list is subject to change from time to time.

Note.—The Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

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Mining and Metallurgy .... " 436
Railway Engineering ....Page 439

INDUSTRIAL MANAGEMENT

EDUCATION

Catalogue

L'Avenir Du Catalogue International De La Littérature Scientifique (85140 B). P. Otlet. 4000 w. Revue Générale des Sciences—Feb. 15, 1918. Future aspect of an international catalogue.

Electrical Courses

Electrical Courses at the School of Engineering of Milwaukee (85192). Ills. 1800 w. Elec Rev, Chi—March 23, 1918. Methods used in teaching electrical theory and practice.

Les Industries De Houille Blanche (85118 B). M. Barbillion. Ills. 2000 w. La Nature—Feb. 9, 1918. Courses in electric power applications at the University of Grenoble, France.

Engineering Trades

The Engineering Pupilage and the Engineering Trade Apprenticeship (84658 A). Algernon E. Berriman. 6000 w. Engng—Feb. 1, 1918. Refers particularly to systems in England for training of engineers.

Engineer Officers

The Battle of the Somme (85073 B). A. V. Gompertz. 24 pp. Prof Mem—March-April, 1918. Lecture delivered at the Officers Cadet Unit in India.

Sapping Operations, Especially for Infantry: From a Lecture to Cadets at Saint Maixant, France (85070 B). A Gay. Ills. 15 pp. Prof Mem—March-April, 1918. Explanation and description of excavations.

Engineer Troops

Instruction of Engineer Troops While in Quarantine (85072 B). Ills. 1000 w. Prof-Mem—March-April, 1918. Report of instruction given by regimental and company commanders.

Hong-Kong

The Engineering Equipment at Hong-Kong University (84843 A). Maps and Plans. 3000 w. Engr—Feb. 15, 1918. Serial, 1st part. The present article describes the port and conditions.

Kelvin

The Ninth Kelvin Lecture (85245 N). Magnus Maclean. Ills. 24 pp. Instn E E, Jl—March, 1918. Kelvin as a teacher.

Laboratory

A National Industrial Research Laboratory (85264 A). 2500 w. Engr—March 1, 1918. Excerpts from a lecture delivered by Sir Richard Glazenbrook at the Royal Institution. National Physical Laboratory to be taken over by the State.

Marine Engineers

Training Engine-Room Crews for America's New Ships (85238). Henry Howard. 1200 w. Power—March 26, 1918. Plan of training inexperienced young men on training ships.

Mining Education

Mining Education and Research in Lancashire; An Appeal for Wider Interest and Greater Support (84936 N). William Pickup, with discussion. 4500 w. Instn Min Engrs, Trans—Jan., 1918. Presidential address.

University Education in Relation to Mining Engineering (84937 N). William Ripper, with discussion. 6000 w. Instn Min Engrs, Trans—Jan., 1918. The movement to prepare trained men for this field.

Naval Academy

The Requirments for Admission to the Naval Academy—An Historical Review (84987 A). C. H. Foster. 15 pp. U S Nav Inst, Pro—Feb., 1918. Reviews various changes that have taken place.

Navy

Training Power-Plant Men for the Navy (85010). Willard Connely. Ills. 1800 w. Power—March 19, 1918. How ship fitters and gas engineers get expert free training for duty with U. S. fleets.

Perspective

Perspective in Engineering Education (84912 A). Clement C. Williams. 1200 w. Eng Ed—Feb., 1918. Point of view of engineering operations.

Research

Industrial and Scientific Research in Italy (85263 A). 2000 w. Engr—March 1, 1918. Information concerning the functions of the Scientific and Technical Committee for Italian industries.

Shipbuilders

Training Shipyard Workers at Staten Island (84737 A). R. V. Rickcord. 3000 w. Int Mar Eng—March, 1918. Shipbuilders' school started by state and city departments of education.

Welders

Instructing Welders (84621) Henry Cave. 1200 w. Weld Engr—Feb., 1918. Welding institute established at Jersey City, N. J.

FINANCE AND COSTS

Bonus System

A Bonus System for Power Houses (84001 A). B. H. Blaisdell. Ills. 9 pp. A E R A—Feb., 1918. Result of nearly three years' trial by the Manila Elec. Ry. & Lgt Co. Success of plan.

Bonus for Power Plant Employees (85230). Warren B. Lewis. 3000 w. Power—March 26, 1918. Based on the saving in costs on unit output of product. Gives directions for quickly determining the bonus due.

British Empire

Our Imperial Strength, Based on the Metal Industries and an Efficient Banking System (84915 N). Octavius Charles Beale, with discussion. 36 pp. West Scot I & S Inst, Jl—Dec., 1917. Review of the National position as to sources and security of supplies of base metals; and financial proposal.

Costs

Cost Estimates and Estimated Costs (85281 A). H. A. Russell. 3000 w. Ind Man—April, 1918. Estimates and costs can be only approximate. Outlines a method of keeping approximate costs.

Relation Between Interest and Manufacturing Costs (84899 A). Edmund C. Gause. 1000 w. Jl Actcy—March, 1918. Some of the reasons why interest should not be included, with arguments.

Capital Charges Considered Along with Current Expenses (84939 N). D. M. Mowat. 1500 w. Instn Min Engrs, Trans—Jan., 1918. How to hold the balance between first cost and maintenance charges.

Spoilage, the Fourth Factor of Cost (84900 A). Frederick W. Kilduff. 1300 w. Jl Actcy—March, 1918. Considers spoiled goods accounting.

Cost-Plus Contracts

Overhead Distribution for Cost-Plus Contracts (84897 A). Frank E. Seidman. 4000 w. Jl Actcy—March, 1918. Some of the important problems of overhead distribution.

Depreciation

Depreciation and Its Relation to Industrial Appraisement (85280 A). Charles W. McKay. 2500 w. Ind Man—April, 1918. Causes of depreciation and methods of computation.

Germany

The Financial Position of the German Iron and Coal Industries (84659 A). 1500 w. Engng—Feb. 1, 1918. Particulars of the capital and profits of the chief firms.

Inventories

Auditors Responsibility in Regard to Verification of Inventories (84898 A). Edward H. Moeran. 3500 w. Jl Actcy—March, 1918. The more important points coming within the scope of the auditor's responsibilities.

Land Appraisals

What the Land Appraisers of the Delaware and Hudson Company Are Doing (84921). George H. Burgess. 2500 w. Eng News-Rec—March 14, 1918. Determining acreage values government requires.

Liberty Loan

Organizing a Factory Liberty Loan Drive (85184). J. Edward Schipper. 3000 w. Auto Ind—March 21, 1918. Method of planning the campaign.

Market Commission

The State Market Commission of California—Its Beginnings, 1915-1917 (85013 N). Carl C. Plehn. 27 pp. Am Ec Rev—March, 1918. Aim to lessen cost of marketing and control prices of certain foods.

Price

Price Maintenance (85014 N). H. R. Tosdal. 20 pp. Am Ec Rev—March, 1918. Legalized maintenance of resale prices.

Public Utilities

The Financing of Public Utilities (84883 A). Nathaniel T. Guernsey. 2500 w. Sci M—March, 1918. Discusses the regulation of public utilities from the financial standpoint.

Railroad Credit

Causes of the Decline in Railroad Credit (84786). John Skelton Williams. 4000 w. Ry Age—March 8, 1918. A letter to the Interstate Commerce Commission outlining conditions which caused the decline.

Railroad Finance

Railroad Finance from the Standpoint of Efficiency (84884 A). Howard C. Kidd. 1500 w. Sci M—March, 1918. Suggests lines conducive to economy of operation, and explains the necessity.

Salesmanship

Engineering Salesmanship (84985 A). Charles W. Hunt. 1700 w. Mech Wld—March 1. 1918. Serial, 1st part. Read before Manchester Assn. of Engineers.

Trade

Must Prepare Now for After-War Trade (84684). J. K. Clark. 2500 w. Auto Ind—Feb. 28, 1918. Need of coöperation for export business.

Valuation

Valuation of Public Utilities (84914 A). V. Y. Davoud. 20 pp. Utah Soc Engrs' Jl—Jan., 1918. Assumes an existing utility for study.

Wages

Problems of Wage Payment (84721 A). H. N. Strouck. 5500 w. Met & Chem Eng—March 1, 1918. General discussion of wage payments, and a description, with charts, of the Benedict-Strouck differential time-bonus system.

Raising Wages With Cost of Living (85003). L. K. Comstock. 2000 w. Elec Wld—March 16, 1918. Serial, 1st part. Plan for paying workers on the basis of living costs.

War Finance

The Broad Point of View on the War and the Industrial Situation (85156). Wingrove Bathon. 2500 w. Am Mach—Feb. 21, 1918. The situation created by the present war.

MANAGEMENT

Coöperation

Extracts from the Address of President Rice at the Midwinter Convention Dinner (84767 D). 2000 w. A I E E, Pro—March, 1918. On the war program and the value of coöperation.

Great War Results Due to Coöperation (84919 A). 4500 w. Iron Age—March 14, 1918. Achievements of the Ordnance Bureau.

How the War Has Taught England Coöperation (84164). William Patten. 1200 w. Am Mach—March 7, 1918. Methods of coöperation in England between labor and capital.

Harmonizing

Under New Management—Harmonizing (85287 A). Charles M. Horton. 2500 w. Ind Man—April, 1918. The value of coöperation.

Industrial Employment

Employment and Personnel Policy of Thomas A. Edison Interests (85254 A). Mark M. Jones. 3000 w. Ind Man—April, 1918. First of a series of articles to show one of the highest developments in the United States of industrial employment work.

Management

Works and Workers (85205). 2000 w. Times Engng Supp—Feb. 22, 1918. Individual management and central control in contrast. Effects on the personnel, etc.

Manufacturing

System at the Lanchester Works (84842 A). Ills. 3300 w. Engr—Feb. 15, 1918. Account of the manufacturing system of the Lanchester Motor Co.

Ordnance

Handling Ordnance Supplies (85163). 4000 w. Am Mach—March 7, 1918. Methods adopted by the Ordnance Department.

Organization

Mass Production at the Winchester Shops (84756 A). W. E. Freeland. Ills. 2500 w. Iron Age—March 7, 1918. Details as typified in making of cartridges.

Thinks Federation of Strong Local Societies Needed for Engineering Unity (84794). C. E. Drayer. From address at Duluth. 3000 w. Eng News-Rec—March 7, 1918. Organization like that of the National Chamber of Commerce advocated.

Utilize the Non-Essential Industries (84754 A). Sterling H. Bunnell. 2500 w. Iron Age—March 7, 1918. Rearrangement of industries for effective war work.

Taxation

Taxation, Rating and Valuation of Mines (85259 A). David Bowen, with discussion. 7000 w. Colly Gdn—March 1, 1918. Read before the Surveyors' Instn. Principles of taxation and taxing systems, reliable value, etc.

Trade Acceptance

The Trade Acceptance in the Supply Field (84652). 2500 w. Ry Age—March 1, 1918. First of two articles showing its important advantage.

REGULATION

Capital and Labor

The Sins of the Capitalist (84662 A). 2500 w. Engng—Feb. 8, 1918. Editorial on the relations of capital and labor after the war.

"Zero" of Capital and Labor (85293 A). Lord Leverhulme, with discussion. 9500 w. Roy Soc Arts, Jl—March 1, 1918. Profitable production and the creation of wealth. Progress of civilization, etc.

Compensation

Comparison of Compensation Acts (84631 A). Chesla C. Sherlock. 2500 w. Machy—March, 1918. Principles on which compensation acts are based and compensation allowed in each state.

Control Bill

Railroad Control Bill Passed by the House (85151). 3500 w. Ry Age—March 22, 1918. Passed in form reported by conferees after elimination of restriction on state taxation.

Railroad Control Bill Passed by the Senate (84973). 6000 w. Ry Age—March 15, 1918. Period limited to 21 months after war.

Control

Graphic Control of Production and Cost (85285 A). C. W. Starker. Charts. 3000 w. Ind Man—April, 1918. Shows how charts visualize performance.

War Industries Being Brought Under Modern Engineering Control (85157). Mont Schuyler. Chart. 2000 w. Am Mach—Feb. 21, 1918. The use of progress charts explained.

Food Control

Government Control of the Wheat Trade in the United States (85015 N). William M. Duffus. 25 pp. Am Ec Rev—March, 1918. Analysis and discussion of the United States Food and Fuel Control Act, passed Aug. 10, 1917.

French Railways

See France, under RAILWAY ENGINEERING, *Conducting Transportation.*

Immigration

A Comprehensive Immigration Policy and Program (84881 A). Sidney L. Gulick. 3500 w. Sci M—March, 1918. Outlines a plan for the regulation and restriction of immigration.

Industrial Problems

Problems of Industrial Reconstruction (84674 A). 2200 w. Engr—Feb. 1. 1918. Work of the Ministry of Reconstruction.

Industrial Relations

Mining Engineers Consider Industrial Relations (84705). R. Dawson Hall. 2000 w. Cl Age—March 2, 1918. Serial, 1st part. Reviews recent sessions of A. I. M. E., discussing industrial problems.

Labor

Employment in Small Plants (85292 A). Allen L. Adams. 2000 w. Ind Man—April, 1918. Suggestions for securing congenial relations and development.

Guiding the Workman's Personal Expenditures (84945). C. J. Shower. Ils. 1800 w. Auto Ind—March 14, 1918. How Ford reduced turnover 350 per cent.

Labor Conditions With Reference to the War (84885 A). Francis Tyson. 2500 w. Sci M—March, 1918. Outlines the courses of labor shortage and expedients available for the solution of the problem.

The Government War-Labor Policy (85177). 1800 w. Am Mach—March 21, 1918. Outlines the tentative proposals of the Administration.

Labor Problems

Administration of War Labor Problems (85277 A). William B. Wilson. 2500 w. Ind Man—April, 1918. Causes of labor difficulties and unrest, with recommendations as to remedies. Outlines the organization of the Department of Labor.

Labor Turnover

Methods of Arriving at Labor Turnover (85289 A). J. M. Van Harlingen and T. J. Dwyer. 1500 w. Ind Man—April, 1918. Results of a number of methods.

Paper Mill

Old Paper Mill Rebuilt for Efficient Operation (84793). Joseph Meltzer. Ills. 4500 w. Eng News-Rec—March 7, 1918. Solutions of problems of routing, machinery, structure and fittings.

Power

Mastering Power Productions—IV (85283 A). Walter N. Polakov. 4500 w. Ind Man—April, 1918. Relations of wages and Power to the labor problem.

Power Economy

Power Economy An Essential Factor in Winning the War (85288 A). W. Rockwood Canover. 4000 w. Ind Man—April, 1918. Points in the economy of power production from the viewpoint of the power station and shop.

Public Utilities

Logic of Public Utility Consolidations (85213). Clarence P. Fowler. 2000 w. Elec Wld—March 23, 1918. Combinations are economical and a public benefit.

Railroad Bill

The Railroad Bill Passed by the Senate (84648). 4800 w. Ry Age—March 1, 1918. Few changes from original form.

Railway Labor

General Order No. 8, Governing Labor Conditions (84647). 1200 w. Ry Age—March 1, 1918. Statement outlining Director General McAdoo's desires as to railway labor.

Standards

International Standard a By-Product of the Great World War (85294 A). Herbert T. Wade. 4500 w. Ind Man—April, 1918. An appeal to carry on the process of standardization for the days of peace.

State Control

Evils of State Control (85149). 4000 w. Naut Gaz—March 14, 1918. Liverpool Steamship Assoc'n does not approve shipping policy of British Government.

Strikes

Strikes and Some Reflections (84696 N). 8 pp. Cham Mines W Aust, Mthly Jl—Nov., 1917. On the strikes that lasted three months in Australia.

Women Workers

Women Workers in Machine Shops in Great Britain (84627 A). 1200 w. Machy—March, 1918. Conditions, training, etc.

Workers

Changing from Male to Female Help (85291 A). W. L. Churchill. 1800 w. Ind Man—April, 1918. Care in selection, supervision, compensation, etc.

WELFARE AND SAFETY

Agriculture

The Palate of Civilized Man and Its Influence on Agriculture (84990 B). David Fairchild. Ills. 18 pp. Fkn Inst, Jl—March, 1918. Taste and fashion in food and their influence.

Benefit Association

The Employees' Benefit Association—IV (85282 A). W. L. Chandler. 3500 w. Ind Man—April, 1918. What benefits are right? Question of supervision of beneficiaries.

Compensation

See same heading under Regulation.

Contracting

Safety Engineering in General Contracting (85275 A). L. D. von Woldtke. 1000 w. Sfty Eng—March, 1918. Methods.

Fatigue

Cause of Industrial Fatigue (85286 A). C. B. Lord. 1500 w. Ind Man—April, 1918. Fatigue and recuperation, and the effect of mental attitude.

Furnace Screens

Protective Screens for Furnaces (85159). J. V. Hunter. Ills. 2500 w. Am Mach—Feb. 28, 1918. Types of shields used to protect workmen.

Lubricants

The Hazardous Use of Oil in Contact With Oxygen Under Pressure (85233 A). B. C. Condit. 1500 w. Weld Engr—March, 1918. Liable to produce an explosive mixture.

Railroad Sanitation

The Sanitarian's Work is Valuable to a Railroad (84972). A. E. Campbell. Ils. 3000 w. Ry Age—March 15, 1918. Outline of work to remove unhealthful conditions on the Illinois Central.

Rescue Work

Mines Rescue Work (85230 N). Robert Watt. 2500 w. Qnsd Gov Min Jl—Feb., 1918. Paper read to trainers at Silkstone, Queensland. Details of apparatus used and outline of work.

Respirators

Les Appareils Respiratoires Clos (85146 B). 2406 w. La Nature—March 2. 1918. The new Gibbs apparatus as designed for mine rescue work, fireman and others.

Textile Industries

Accident Prevention in Textile Industries (85276 A). David Van Schaack. 5000 w. Sfty Eng—March, 1918. Address at Boston. Features of Safety work. Devices used, etc.

Wood Alcohol

Dangers in the Manufacture and Industrial Uses of Wood Alcohol (84890 N). Ills. 15pp. N Y Dept Labor, Bul 86—Dec., 1917. Investigates conditions of manufacture, and use in the industries, proposing rules to eliminate dangers.

MISCELLANY

Economic Conditions

The Present Economic and Social Conditions as Results of Applied Science and Invention (84882 A). George W. Perkins. 2500 w. Sci M—March, 1918. Outlines past and future progress due to science and invention, and the need of educating the public.

Securing Employment

How I Landed My Job (85290 A). L. A. Terven. 1500 w. Ind Man—April, 1918. Value of personal interviews, introduction of friends, etc.

War Industries

The Work of the Machine-Tool Section of the War Industries Board (85167). 2500 w. Am Mach—March 7, 1918. Report of principal activities.

MECHANICAL ENGINEERING

AERONAUTICS

Aeroplanes

L'Èvolution De L'Aviation Allemande (85116 B). J. A. Lefranc. Ills. 4000 w. La Nature—Feb. 9, 1918. Development of aviation in Germany. First part, air planes.

On the Maximum Flight Value of Aeroplanes (84805). Umberto Nobile. 2500 w. A A Wkly—March 11, 1918. A study.

Wing Bracing and Head Resistance (85215). Marco Polo. Ills. 1200 w. A A Wkly—March 23, 1918. Progress made.

Aircraft

Military Aircraft and Their Armament (84715). Jean Abel Lefrance. Ills. 3000 w. A A Wkly—March 4, 1918. Technical elements to be considered.

Aircraft Mechanics

Tools and Fixtures for Aircraft Mechanics (85169). B. Z. Reiter. Ills. 900 w. Am Mach—March 14, 1918. Details of a number of useful tools for airplane work.

Aviation Motors

Carburants and Lubricants for Aviation (84803). Umberto Pomilio. Ills. 2000 w. A A Wkly—March 11, 1918. A study of these substances with analysis and control of their requisites. Results obtained in service.

Engines

The Engines of the Zeppelin and the Gotha (84846 A). Ills. 3500 w. Engr—Feb. 22, 1918. Serial, 1st part. Full particulars of the "Maybach" motor, and the "Mercédès" engine.

Propellers

La Fabrication Des Hélices D'Aéroplanes (85122 B). 1200 w. Le Genic Civil —Feb. 2, 1918. The Wadkin Machine for fashioning airplane propellers.

Range Finders

The Principles of Range Finders and Bomb Sights for Aircraft (84804) C. Levick. 1500 w. A A Wkly—March 11, 1918. General elementary principles.

Route Indicator

The "Crocco" Route Indicator and Its Noteworthy Applications (84979) Ills. 5000 w. A A Wkly—March 18, 1918. Describes measurements and applications, etc.

Spinning

Spinning (85216). Dean I. Lamb. 2000 w. A A Wkly—March 25, 1918. A study of the problem

AUTOMOBILES

Design

American Automobile Design (84825 A). A. Ludlow Clayden. Ills. 2500 w. Autocar—Feb. 16, 1918. Serial, 1st part. Explains disadvantage of large outputs; the problem of heavy grade fuel, etc.

Automatic Design and Transportation as Developed by the War (84683). J. Edward Schipper. Read before Detroit Sec. of S. A. E. 3500 w. Auto Ind—Feb. 28, 1918. Tendencies in design revealed by new models.

Electric Trucks

How the Electric Truck Releases Men for Productive Work. (85279 A). F. C. Myers. Ills. 1800 w. Ind Man—April, 1918. Types and their uses and operation.

Electric Vehicles

Electric Vehicle a Factor in Transportation Engineering (84950). Ills. 2000 w. Elec Rev. Chi—March 16. 1918. Growth in use of electric vehicles; economies.

Engines

U. S. A. Motorcycle Engine Completed (85183). P. M. Heldt. Ills. 3000 w. Auto Ind—March 21, 1918. Of two-cylinder, vee, air-cooled type, capable of developing 15 B hp.

Fuels

Heated Passage vs. Hot-Spot System (84947). Percival S. Tice. 1800 w. Auto Ind—March 14, 1918. Comparison of the two methods.

Ignition

Testing Electric Ignition Apparatus (84660 A). J. D. Morgan. Ills. 1000 w. Engng—Feb. 8, 1918. Note on the measurement of current in electric ignition spark circuits.

Lubrication

New Methods of Chassis Lubrication (84681). Cornelius T. Myers. Ills. 4000 w. Auto Ind—Feb. 28, 1918. Designs for minimizing attention and increasing life.

Motor Truck

Parcel Post by Motor Truck (84954). 3000 w. Br Rds & Sts—March, 1918. Address of Hon. James J. Blakslee at the War Roads Convention, Columbus, O.

Petrol Storage

The Storage of Petrol (85242 A). 1800 w. Autocar—March 9, 1918. Present position and the effect of a regulation issued under the Defense of the Realm Act.

Repair Depot

First Standardized Repair Depot for Quartermaster Mechanical Transport (84948). Allen Sinsheimer. Ills. 1000 w. Auto Ind—March 14, 1918. Depot to supply cantonments. Model for others here and in France.

Snow Removal

New York State Failed to Remove Snow (84790). David Beecroft. 2500 w. Auto Ind—March 7, 1918. War trucks average 37.4 miles per day in Empire State but 6.7 miles over Detroit-Seaport route. Difference due to snow removal.

Springs

The Mechanics of Tractor Spring-Mounting (84946). E. Goldberger. Ills. 2500 w. Auto Ind—March 14, 1918. Analytical investigation of effects when tractors pass over rigid obstacles.

Traction

Traction on Bad Roads of Land (84791). L. A. Legros. Read before Inst. Mech. Engrs. Ills. 3500 w. Auto Ind—March 7, 1918. Serial, 1st part. Comparison of wheel and chain-track methods of drive.

Tractors

New French Vineyard Tractor (85186). W. F. Bradley. Ills. 1500 w. Auto Ind—March 21, 1918. Double worm drive in real axle: tread 37 inches.

La Moto-Armatura Di Stato In Italia (85105 B). A. Marozzi. Ills. 2000 w. Industria—Jan. 31, 1918. Development of the Agricultural tractor in Italy.

Tractor Gear Teeth and Materials (85185). A. W. Searratt. 1500 w. Auto Ind—March 21, 1918. Materials available for gears and their properties.

The Most Economical Size of Tractor (84792). E. Goldberger. 2000 w. Auto Ind—March 7, 1918. Analysis of costs of power plowing with tractors of different sizes. Read at Chicago meeting of S. A. E.

Trucking

Connecticut Establishes First Statewide Return Loads Bureau (84868 A). Joseph Husson. Ills. 1700 w. Com Vhle—March 1, 1918. Work proves a success. Roads cleaned of snow.

Trucks

Opposition to Standardized Trucks (84682). 1500 w. Auto Ind—Feb. 28, 1918. Convincing arguments advanced by both sides.

Trucks for Overland Hauls as Seen from Goodyear Experiences (84870 A). Ills. 1800 w. Com Vhle—March 1, 1918. New Features of latest design.

Truck Service

Trucks Prove Best Means of Transportation in City and Rural Mail Service (85002 A). 1500 w. Com Vhle—March 15, 1918. From report of Postmaster Burleson comparing commercial vehicles with other conveyances.

Twice-a-Week Truck Service from Boston to New York (85001 A). Ills. 1200 w. Com Vhle—March 15, 1918. Two 5-ton trucks run each way every week.

Vaporization

Pre-heating the Air (85243 A). W. C. F. Redmond. Ills. 1000 w. Autocar—March 9, 1918. Effect upon fuel consumption of increasing the carburetter air temperature. Report of tests.

Wheels

A Century of Wheels (85241 A). Charles G. Harper. Ills. 1200 w. Autocar—March 2, 1918. Facts concerning the earlier development of tires and springs.

COMBUSTION MOTORS

Engines

Frost Precautions for Internal Combustion Engines (84670 A). 2000 w. Mech Wld—Feb. 8, 1918. Methods suggested for water-cooled types.

Gas Engines

The Multi-cylinder Gas Engine in Its Modern Development (85257 A). Ills. 1300 w. Mech Wld—March 8, 1918. Advantages of the enclosed type.

HEATING AND COOLING

Cost

Meeting the High Cost of Heating and Ventilating Apparatus (85051). Ills. 3000 w. Heat & Vent Mag—March, 1918. With suggestions for proposed system to reduce cost of installation and operation.

Forecoolers

Suction Gas Fore Coolers (84807 A). George J. Trosper. 2000 w. Ice & Refrig—March, 1918. Superheated suction gas as affecting capacity and compressor efficiency. Types of forecoolers and their operation.

Heating Demand

Average and Maximum Heating Demand (84710). M. W. Ehrlich. 1800 w. Power—March 5, 1918. Method of computing the coal consumption.

Refrigeration

Mechanical Refrigeration (84640). 4500 w. Natl Engr—March, 1918. Various refrigerating mediums and how used.

Relation Between Efficiency of Refrigerating Plants and the Purity of Their Ammonia Charge (84763 B). F. W. Frerichs. Ills. 8000 w. Jl Ind & Eng Chem—March, 1918. Apparatus and experiments.

The Economy of a Refrigerating Power Plant (84909 A). Victor J. Azbe. 3500 w. E Cb St L, Jl—Jan.-Feb., 1918. Study of losses.

The Selection of Ammonia Condensers (84851). M. A. Saller. 1700 w. Power—March 12, 1918. Suggestions to assist the engineer in getting acquainted with the chief factors that should guide him.

Steam and Electric

Public Steam and Electrical Systems (84802). J. A. M'Hollan. 2000 w. Elec Wld—March 9, 1918. Analysis of the building heating situation in large cities.

University Buildings

Measurements of Low Pressure Steam Used for Heating the Buildings of the University of Michigan (85052). J. E. Emswiler. 2500 w. Heat & Vent Mag—March, 1918. Data relative to the amount of steam required, with description of method of measurement.

Warehouse

Large Apple Storage Warehouse (84806 A). Ills. 1200 w. Ice & Refrig—March, 1918. Concrete fireproof building in Winchester, Va., with equipment.

HYDRAULIC MACHINERY

Laboratory

See same heading under Measurement.

MACHINE ELEMENTS AND DESIGN

Crankshafts

Problems of Crankshaft Design (84641 A). Otto M. Burkhardt. Ills. 5000 w. A S M E, Jl—March, 1918. Mathematical deductions from examples are utilized to derive factors of safety and other specific values.

MACHINE WORKS AND FOUNDRIES

Aluminum

The Practice of Melting and Casting Aluminum (84750). Robert J. Anderson. 2500 w. Fndry—March, 1918. Serial, 1st part. Effects of overheating, and results of experiments with dioxidizers.

Baling

Scrap Metal Baling Press (84657 A). Ills. 800 w. Engng—Feb. 1, 1918. Built by Canadian-American Machinery Co., Ltd.

Bearings

Manufacture of a Self-Lubricating Bearing Material (84635 A). Ills. 1500 w. Machy—March, 1918. Production of "Graphalloy" by an impregnating process.

Browning Gun

The Browning Machine Rifle and Gun (85173). Ills. 1500 w. Am Mach—March 21, 1918. Details of machine guns which will be the standard equipment of the U. S. army in France.

Castings

How Steel Castings Are Made in California (84753). Ills. 2500 w. Fndry—March, 1918. Account of the development of the industry on the Pacific Coast.

Patterns and Core Boxes for Gas Engine Beds (84749). Joseph Horner. Ills. 1500 w. Fndry—March, 1918. English practice described.

Cutters

Cutters for Spur and Helical Gears (84-007 B). W. F. Mallory. Ills. 1600 w. Univ Col Jl Eng—Jan., 1918. Proper selection of cutters.

Cutting Tools

Milling Cutter Rake and Clearance (84,984 A). George W. Burley. 1400 w. Mech Wld—March 1, 1918. Explains effects of the angle of rake, etc.

Die-Castings

The Manufacture and Use of Die-Castings (85189 B). Charles Pack, with discussion. Ills. 25 pp. Engrs' Soc W Penn, Pro—Jan., 1918. History and evolution, die construction, properties, etc.

Differential Motions

Differential Motions and Planetary Gear Combination (84628 A). Franklin D. Jones. Ills. 4000 w. Machy—March, 1918. Serial, 1st part. Mechanisms requiring differential motion and methods of determining relative velocities of planetary or differential gears.

Electric Furnace

Four Électrique Sans Électrodes (85,131 B). Ills. 1000 w. L'Industrie Électrique—Feb. 10, 1918. Electric furnace without electrodes. Lellis system.

Electric Melting

The Electrical Melting of Nonferrous Metals (84751). Dwight D. Miller. 5500 w. Fndry—March, 1918. Summary of results of experiments. Faults of present foundry practice.

Foundries

William Kennedy & Sons, Limited (84,745). Ills. 2500 w. Can Fndman—Feb., 1918. Foundry and marine equipment shop at Owen Sound, Ont., sixty years old. Development, etc.

Furnaces

Melting Furnaces (84669 A). T. W. Aitken. Read before British Found. Assn. 2000 w. Mech Wld—Feb. 8, 1918. Types and the work for which they are suited.

Heat Treating and Annealing Furnace with Oil Fuel Equipment (84980). Ills. 1200 w. Can Fndman—March, 1918. Detailed description.

Fuse

Manufacturing Base Plugs for the 80 Mark VIII Time Fuse (85165). John Campbell. Ills. 1200 w. Am Mach—March 7, 1918. Tools and operations used.

Fuse Manufacture

Manufacturing Time Fuse Rings (84,632 A). Donald A. Baker. Ills. 2500 w. Machy—March, 1918. Characteristics of machines for routing powder groove.

Gage Grinding

Interesting Examples of Gage Grinding (85176). S. A. Hand. Ills. 700 w. Am Mach—March 21, 1918. Work in shops of the Blair Tool and Machine Works, Inc.

Gages

Notes on General Gaging and the manufacture of Gages (85172). H. James. Ills. 1500 w Am Mach—March 10, 1918. Some of the pitfalls found and the remedies.

Some Types of Gages for Munitions of War (85170). H. J. Bingham Powell. 1000 w. Am Mach—March 21, 1918. Hints on gage making.

Gears

Graphic Method of Generating an Involute Gear Tooth (84630 A). Douglas T. Hamilton. Ills. 1300 w. Machy—March, 1918. Easy method of laying out gear teeth.

Grinding Hobs

Grinding Hobs to Remove Distortion (84625 A). Edward K. Hammond. Ills. 3500 w. Machy—March, 1918 Methods used by the Illinois Tool Works, Chicago.

Guns

Musket Manufacture in Past Centuries (85161). H. H. Manchester. Ills. 1000 w. Am Mach—Feb. 28, 1918. Methods of the 16th, 17th and 18th centuries.

Handling Work

Handling Production in a Small Shop (84916 A). Robert Thurston Kent. 3500 w. Iron Age—March 14, 1918. Planning and progress of work.

Jigs

A Crank Case Trunnion Jig (85174). Ills. 1000 w. Am Mach—March 21, 1918. For use in drilling holes in crank case of a 12-cylinder internal combustion motor.

Laboratory

U. S. Metals Refining Co.'s New Laboratory at Chrome, N. J. (84818). B. B. Hood. Ills. 1600 w. Eng & Min Jl—March 9, 1918. Chemical laboratory with facilities for all branches of analytical work.

Machine Tools

Manufacture of Machine Tools in Switzerland (85175). C. E. Carpenter. 2000 w. Am Mach—March 21, 1918. Machines are now being exported.

Molding

Sweeping Molds in Loam (84828 A). Charles A. Otto. Ills. 1600 w. Mech Wld—Feb. 22, 1918. Directions.

Munitions

How Semisteel Shells Are Being Made in France (84748). E. Ronceray. 4000 w. Fndry—March, 1918. Methods of using this metal.

Manufacture of the U. S. 75-Millimeter Shell (84626 A). Erik Oberg. Ills. 2500 w. Machy—March, 1918. Serial, 1st part. Approved methods employed by the Am. Shell Co.

Manufacture of the 75-MM. High-Explosive Shell (85168). S. A. Hand. Ills. 1500 w. Am Mach—March 14, 1918. Serial, 1st part. Methods used by the Worthington Pump and Machinery Corporation, at Hazleton, Penn.

Special Machines for Producing 9.2-Inch Shells (85265 A). Ills. 1000 w. Engr—March 1, 1918. Describes a series of specially designed tools for producing high explosive shells.

Patterns

Practical Economies in Pattern Building (85162). W. Rockwood Conover. 2000 w. Am Mach—Feb. 28, 1918. Opportunities for more efficient methods.

Pipe Foundry

Making Good with Tradition Discarded (84752). Ills. 4000 w. Fndry—March, 1918. Development of an industrial community around a pipe foundry near Birmingham, Ala.

Sand-Blast

Development of the Pneumatic Sand-Blast (85180). Glenn B. Harris. Ills. 3500 w. Am Mach—March 21, 1918. Some of the recent improvements.

Scrapers

Hand Scrapers (84634 A). C. C. Marsh. Ills. 1100 w. Machy—March, 1918. Types and information concerning their making and use.

Screw Threads

General Thread Cutting Practice in the Lathe (84636 A). Franklin D. Jones. Ills. 6000 w. Machy—March, 1918. Important points on cutting single, multiple, and tapering threads by means of single point tools and chasers.

Shells

The Making of Pressed Sheet Metal Shells (84983 A). G. W. Smith. Ills. 1000 w. Mech Wld—March 1, 1918. Explains some of the fundamental principles.

Shop Practice

Emergency Methods of Cutting and Drilling Glass Disks (85170). J. A. Lucas. Ills. 1200 w Am Mach—March 14, 1918 Tools and methods that may be used in the average small shop.

Manufacturing the Addressograph (85,178). M. E. Hoag. Ills. 1000 w. Am Mach—March 21, 1918. Processes described.

Shop Problems

Drilling Jig for Dust Cover (84827 A). W. Richards. Ills. 500 w. Mech Wld—Feb. 22, 1918. Two solutions of the problem are given.

Shops

A Modern Light Machine Shop (84675 A). Herbert Carpenter. Ills. 2800 w. Engr—Feb. 1, 1918. Details of a particular form of construction and its advantages, with various aspects of the general question.

Springs

Device for Winding Springs (84629 A). Gustave J. Horak. Ills. 1200 w. Machy—March, 1918. Describes device and its use.

Steel Sheets

The Manufacture of Steel Sheets (84,917 A). Clement F. Poppleton. Ills. 4500 w. Iron Age—March 14, 1918. Serial, 1st part. General layout and range of product.

Tool Steel

Manufacture of Electric Tool Steel (85,158). E. A. Suverkrop. Ills. 4500 w. Am Mach—Feb. 28, 1918. Methods of manufacture in the electric furnace.

Welding

Boiler Welding (85234 A). Ills. 1800 w. Weld Engr—March, 1918. Progress in field of boiler repairs.

Electric Welding Stops Leaks in Girth Seams (85011). Romeo A. Grise. 1300 w. Power—March 19, 1918. Leakage due to fire-cracks at the seam over the fire.

Notes on Welding Systems (84941 N). James Caldwell, with discussion. Ills. 33 pp. Instn E & S Scot, Trans—Feb., 1918. Nature of processes, grouping them under smith welding and fusion welding.

Thermit Welding and Oxy-Acetylene Welding (85235 A). J. H. Deppeler. Reprinted from *Reactions*. 2500 w. Weld Engr—March, 1918. Their respective fields and applications.

Welding and Cutting Processes in Boiler Work (84743). A. F. Dyer. 2500 w. Pr House—Feb., 1918. Read before Can. Ry. Club. Value of acetylene and electric systems.

Welding in Gas Main Construction (84,620 A). M. S. Clark. 1800 w. Weld Engr—Feb., 1918. Advantages explained.

Welding Locomotive Cylinders (85232 A). B. Kopperschmidt. Ills. 1500 w. Weld Engr—March, 1918. The problem of quick repairs.

Wheels

Manufacture and Use of Chilled Iron Wheels (84034 N). F. K. Vial, with discussion. Ills. 50 pp. N E Rd Ch—Feb. 12, 1918. Physical properties that make it of value for wheel service, etc.

MATERIALS OF CONSTRUCTION

Alcohol

Power-Alcohol (84906 A). 1000 w. Aus Min Stan—Feb. 14. 1918 Serial, 1st part. Alcohol as a fuel.

Alloys

Report of Sub Committee III on Sand Cast Metals and Alloys (85078 N). Ills. 13 pp. Am Soc Test Mats, Pro—June, 1917. Results, with descriptive letters from different authorities on results obtained

Ammonia

Recovering Ammonia at Tar-Distilling Plants (84058 A). Clarence R Woodward. 2500 w Met & Chem Eng—March 15, 1918. Shows that it may be profitably recovered.

Condenser Tubes

Condenser Tube Failure—Photomicrography (85044 F). F. W. Sterling. Ills. 800 w. Am Soc Nav Engrs, Jl—Feb., 1918. Usefulness of the photomicrograph in diagnosing the course of condenser-tube leaks.

Electrical Porcelain

Experimental Investigation of Porcelain Mixes (84759 A). G. I. Gilchrest and T. A. Klinefelter. Ills. 3500 w. Elec Jl—March, 1918. The requirements, investigations, and conclusions of a research.

Metal Coatings

Report of Sub-Commitee II of Committee A-5 on Preservative Metallic Coatings for Metals (85077 N). 34 pp. Am Soc Test Mats, Pro—June, 1917. Investigations and results, with short discussion.

Refractory Brick

Slag Test for Refractory Brick Used in the Iron and Steel Industry (85081 N). C. E. Nesbitt and M. L. Bell. 900 w. Am Soc Test Mat, Pro—June, 1917. Tests and results.

Rubber

Rubber and Jelutong (84957 A). Frederic Dannerth. 2500 w. Met & Chem Eng—March 15, 1918. Review of the evidence in the recent Customs House dispute as to classification of gums.

The Vulcanization of Rubber (84722 A). Andrew H. King. 5400 w. Met & Chem Eng—March 1, 1918. Theory and practice are discussed in detail.

Steel

The Hardening and Tempering of Steel (84829 A). C. A. Edwards. Read before Manchester Assn. of Engrs. 2500 w. Mech Wld—March 22, 1918. Serial, 1st part. Carbon, and nickel steels are discussed in present article.

MEASUREMENT

Air Metering

Displacement Tanks for Metering Compressed Air (85271). Walter S. Weeks. Ills. 900 w. Com Air Mag—March, 1918. Description.

Alignment

Alignment Charts (84633 A). George L. Hedges. 2500 w. Machy—March, 1918. Explains principles governing construction and illustrates use.

Boiler Stresses

Calculation of Boiler Stresses (84862 A). G. E. Parks. 1500 w. Ry Mech Engr—March, 1918. Series of diagrams that will save time and labor in figuring strength and efficiency of seams.

Bolt Stresses

Stresses in Bolts in Fulcrum Brackets (84864 A). Victor M. Summa. Ills. 1000 w. Ry Mech Engr—March, 1918. Analyzes typical cases showing general principles involved.

Chart

Alignment Chart for Feeds, Speeds, and Power of Lathe Tools (85171). A. Lewis Jenkins. Chart. 800 w. Am Mach—March 14, 1918. For quickly solving problems by graphical means.

Laboratory

The Hydraulic Laboratory of the Massachusetts Institute of Technology (85050 B). George Edward Russell. Ills. 1500 w. Bos Soc C E, Jl—March, 1918. Facts and descriptions.

Metric System

A Case for the Adoption of the Metric System (and Decimal Coinage) by Great Britain (84822 N). A. J. Stubbs. 5000 w. Instn E E Jl—Feb., 1918. History of the system and its advantages and disadvantages.

The "Pros and Cons" of the Metric System (84821 N). Llewellyn B. Atkinson. 6000 w. Instn E E, Jl—Feb., 1918. Discussion of the real issues, with suggestions for reconciling conflicting views.

Pitot Tube

Measuring Air and Gases with the Pitot Tube (85272). A. H. Anderson. Ills. 5000 w. Instn E E Jl—Feb., 1918. History of the system and its advantages and disadvantages.

Tool Steels

Organisation Scientifique De L'Usinage (85142 B). P. Denis. Ills. 7100 w. Le Génie Civil—Feb. 23, 1918. Serial, 1st part. Researches and tests on tool steel adapted to lathe work, milling and drilling.

Worm Gearing

The Strength of Worm-Gearing (84993 A). Howard Ensaw. Ills. 1000 w. Mech Wld—Feb. 15, 1918. Simple method of determining the safe load.

POWER AND TRANSMISSION

Compressed Air

Scarcity of Men and Growing Use of Air in Railroad Maintenance (85269). Ills. 1400 w. Com Air Mag—March, 1918. Its adaptation to various kinds of work.

Forge Shops

Compressed Air for Forge Shops (84880). Charles A. Hirschberg, in *Am. Drop Forger*. Ills. 2000 w. Com Air Mag—Feb., 1918. Explains its advantages and use.

Hydraulic Jacks

Hydraulic Jacks: Their Use and Maintenance (84994 A). G. H. Boot. Ills. 1500 w. Mech Wld—Feb. 15, 1918. Serial, 1st part. Troubles due to lack of care.

Lubrication

Lubricating Air Compressors (84725 A). From a paper before the Lubricating Engrs' Assn. 2500 w. Ry & Loc Eng—March, 1918. Requirements, quality of oil, etc.

Lubrication of Ball Bearings (85155). Otto Bruenauer. Ills. 4000 w. Am Mach—Feb. 21, 1918. Serial, 1st part. Characteristics of oils and greases as affecting lubrication, with suggestions.

Oil-Burning Plant

Tamarack Mills Power Plant (85237). Charles H. Bromley. Ills. 1500 w. Power—March 26, 1918. Chief features of a new oil-burning plant at Pawtucket, R. I.

Power Plants

Plant Improvements Resulting in Coal Saving (84693). 2500 w. Pwr Pt Eng—March 1, 1918. Recommendations by engineer.

STEAM ENGINEERING

Boilers

Possible Saving in Avoiding Leaks in Boiler Setting (84852). J. M. Aarons. 1700 w. Power—March 12, 1918. Air leakage due to cracked settings and porous bricks can be reduced by coating the brickwork.

Fuels

Combustion of Coal and Design of Furnaces (84878 A). Henry Kreisinger, C. E. Augustine and F. K. Ovitz. Ills. 137 pp. U S Bur Mines—Bul. 135. A study of the combustion of coal in industrial furnaces.

Gas Firing

Discussion on "Gas Firing Boilers" (84824 N). 5000 w. Instn E E, Jl—Feb., 1918. Discussions at Birmingham and Scottish Local sections, of T. M. Hunter's paper.

High Vacuum

First Report of the Council of the North East Coast Institution of Engineers and Shipbuilders on Certain Methods of Producing High Vacuum (84942 N). Edwin L. Orde, C. Waldie Cairns, and J. Morrow. 50 pp. N-E C Instn, Trans—Feb., 1918. Apparatus investigated.

Powdered Coal

Powdered Fuel for Steam Raising (85,203). 2000 w. Times Engng—Supp—Feb. 22, 1918. Serial, 1st part. Principles, history, what fuels to use, drying, etc.

Steam

Economy in Steam Generation (85204). 1800 w. Times Engng Supp—Feb. 22, 1918. Tests on, stack and uptake gases, soot filters, automatic recorders, etc.

Superheaters

Superheater Operation (85256 A). From *The Locomotive*. 1500 w. Mech Wld—March 8, 1918. Types and their efficiency and management.

Turbines

A Mixed Pressure Steam Turbine (84,690). Ills. 1800 w. Pwr Pt Eng—March 1, 1918. A 2000 kw. turbine, running at 3000 r.p.m.

Tosi Marine Steam Turbines (84740 A). Ills. 800 w. Int Mar Eng—March. 1918. Types of turbines built in Italy for naval and merchant vessels.

Wreck of a Thirty-five Thousand Kilowatt Turbine (85009). Ills. 3500 w. Power—March 19, 1918. Account of the wreck of a horizontal single-cylinder impulse steam turbine in the O street station of the Boston Elevated Ry. Co., Feb. 14, 1918.

Uniflow Engines

Notes on the Uniflow Steam-Engine (84940 N). G. G. T. Poole. with discussion. Ills. 8000 w. Instn Min Engrs, Trans—Jan., 1918. Conditions to be considered before installing a uniflow engine, methods of working, and advantages over other types.

TRANSPORTING AND CONVEYING

Coal Handling

Railway Truck Tipplers (85262 A). Ills. 1500 w. Colly Gdn—March 8, 1918. Plan and description of coal-handling plant at Acton Lane.

Handling Devices

British Shell-Shop Handling Devices (85278 A). George Frederick Zimmer. Ills. 4000 w. Ind Man—April, 1918. Types of runways, conveyors, elevators, and trucks for lifting and transporting shells.

MISCELLANY

Filtration

Plate-and-Frame Filtration (84724 A). D. R. Sperry. Ills. 1000 w. Met & Chem Eng—March 1. 1918. Details of filter-presses and the principle of operation of press named.

ELECTRICAL ENGINEERING

COMMUNICATION

Power Plants

The Figuring of the Power Plant (84,978). P. A. Price. Ills. 5500 w. Telephony—March 16, 1918. Data required for determining power plant for common battery exchanges.

Radiotelegraphy

Radiotelegraphy and Radiotelephony (84988 B). S. M. Kinter. Ills. 29 pp. Engrs' Soc W Penn, Pro—Dec., 1917. The part radiotelegraphy is playing in the ar, with outline of the theory.

ELECTRO-CHEMISTRY

Cells

Dry Cells and the Wet Batteries (84,808). William J. Herdman. 4000 w. Telephony—March 9, 1918. Primary and secondary types of cells. Construction of dry cells and their care.

Corrosion

Corrosion of Iron and Steel and Its Prevention (84747). Abe Winters. 1500 w. Can Fndman—Feb., 1918. Serial, 1st part. Relative corrosion, etc.

Electroplating

Wartime Production Methods (85273). Charles Pack. 2200 w. Brs Wld—March, 1918. Methods of producing metal parts; plating die castings, etc.

ELECTRO-PHYSICS

Insulation

See same heading under Transmission and Distribution.

Light

Ensayo de determination del equivalente mecánico de la luz (85104 A). P. P. De Aguiar. 6800 w. Rev Soc Cubana De Ingenieros—Feb., 1918. A research to determine the mechanical equivalent of light.

Meteorology

Meteorology: Thunderstorms (84716). W. G. Duffield. Ills. 1800 w. A A Wkly—March 4, 1918. Explains forms which lightning may take, and the use of lightning conductors, production of ozone, etc.

Radio Active Salts

Les Sels Lumineux Radifères (85117 B). F. Colomer. 1200 w. La Nature—Feb. 9, 1918. Rare earths and other radioactive substances.

Radioactivity

The Constancy of the Radioactivity of Certain Philippine Waters (84889 N). George W. Heise. 600 w. Phil Jl Sci—Nov., 1918. Data indicating remarkable constancy for long periods.

The Radioactivity of the Waters of the Mountainous Region of Northern Luzon (84888 N). George W. Heise. Plate & Ills. 2500 w. Phil Jl Sci—Nov., 1917. Study and tests showing the phenomenon is probably most common among waters of volcanic origin.

Ultraviolet-Rays

Ultraviolet Energy and Its Use (84720 A). M. Luckiesh. 4000 w. Met & Chem Eng—March 1, 1918. Fundamental principles of ultraviolet light, with discussion of the various sources.

GENERATING STATIONS

Central Stations

A Standardized Method of Unit Construction for Central Stations (84815). Ills. 2000 w. Elec Rev, Chi—March 9, 1918. Sectionalized construction employed by the commonwealth Edison Co.

Coal Supply

Coal Supply Made Sure by Buying Mines (84798). 2200 w. Elec Wld—March 9, 1918. Reasons why the Commonwealth Edison Co. began fourteen years ago to buy coal mines and lands.

Electric Service

Why Electric Service Must Be Maintained (84814). F. H. Bernhard. Ills. 2500 w. Elec Rev, Chi—March 9, 1918. Power supply an essential element in winning the war.

Hydro-Electric

Hydro-Electric Power in Northern and Central California (84858). Map. 1500 w. West Eng—March, 1918. Interconnection between systems and the benefits.

De Waterkrachtindustrie in Scandinavië en over het waterkrachtvraagstuk in Nederlandsch-Indië (85107 B). A. Groothoff. Ills. 16,000 w., with discussion. Ingenieur—Jan. 12, 1916. Water power developments in Scandinavia and their bearing upon the Dutch East-Indies.

The Hydroelectric Situation Up to Date (84757 A). Calvert Townley. 2000 w. Elec Jl—March, 1918. Discusses economic and legislative conditions.

Interconnection

Interconnection of Plants in Massachusetts. Also, Typical Benefits from Plant Interconnection (84706). Map. 1500 w. Elec Wld—March 2, 1918. Economic movement of importance.

Trend of Public Utility Interconnection (84816). Maps. 2500 w. Elec Rev, Chi—March 9, 1918. Movement toward interconnected generating and transmission systems.

Isolated Plants

The Forcible Shutting Down of Isolated Power Plants (85240). Percival R. Moses. 2000 w. Power—March 26, 1918. Account of events that led to the hearings before the N. Y. Public Service Commission on the advisability of substituting central-station service, to save coal.

Italy

Electrical Energy from the Volterra "Soffioni" (84677 A). Ills. 1000 w. Egnr—Feb. 8, 1918. Account of methods to utilize the steam of hot springs for producing power.

Power Development

Smooth Rock Falls Power Development (84685). E. W. Neelands. Ills. 3000 w. Can Engr—Feb. 28, 1918. Plant completed in one year.

Power Plants

Joliet Plant of the Public Service Co. (84691). Ills. 3000 w. Pwr Pt Eng—March 1, 1918. Features indicating changes in modern practice.

Ninety-five Thousand Kilowatt Addition to Northwest Station (84850). Ills. 2500 w. Power—March 12, 1918. Details of installation of three additional turbo-generators of an aggregate capacity of 95,000 kw.

Steam-Electric Plant Dominion Power and Transmission Co., Hamilton, Ont. (84741). Ills. 6000 w. Pr House—Jan., 1918. Excellent design and arrangement.

Rand

Electrical System of the Rand Power Companies, with Special Reference to Methods of Operation and Experience (85248 N). Bernard Price. 32 pp. S Af Inst Elec Engrs, Trans—Dec., 1917. Reply to discussion, taking up each question.

Records

Record Keeping for Isolated Power Plants (84637). Frederick C. Ruck. 4000 w. Natl Engr—March, 1918. Value of records. Reports of boiler tests, etc.

Rochester

New Station No. 5 of the Rochester Railway & Light Company (85190). P. B. Findley. Ills. 2000 w. Elec Rev, Chi—March 23, 1918. Hydro-electric station to carry load peaks of combined system.

Small Plant

Unique Features of a Small Electric Generating Plant (84701). A. R. Zahorsky. Ills. 1500 w. Elec Rev, Chi—March 2, 1918. Combined water-power and oil-engine plant in Ozark Mts.

GENERATORS AND MOTORS

Armatures

Rewinding Direct-Current Armatures (84718). R. Thistlewhite. Ills. 3000 w. Power—March 5, 1918. General principles to be observed.

Carbons

The Action of Dirt on Railway Motor Carbons (84762 A). J. S. Dean. Ills. 1000 w. Elec Jl—March, 1918. Interesting tests and results.

D. C. Generator

The Direct Current Generator (84997 N). E. B. Millar. 1200 w. Comwh Engr—Feb. 1, 1918. Serial, 1st part. Results of experimental tests of the relations between speed, generated electromotive force, magnetic flux, armature conductors, and the field exciting forces.

D. C. Machinery

Outline of Course in Direct-Current Machinery (84913 A). H. C. Bartholomew. 13 pp. Eng Ed—Feb., 1918. Presents outline suggested.

Design

Notes on the Design of Electromagnetic Machines (84826 A). Stanley Parker Smith. 2000 w. Elec'n—Feb. 15, 1918. Third part of a serial. Deals with the design of an a.c. turbo-generator.

Induction Motor

Théorie Simplifiée Du Moteur D'Induction Monophasé (85130 B). A. Normier. Ills. 2100 w. L'Industrie Électrique—Feb. 10, 1918. Serial, 1st part. Theory of the single phase induction motor treated by simple mathematics.

Motor Selection

Selection of Motors Aided by Graphic Meters (84708). C. E. Clewell. Ills. 2000 w. Elec Wld—March 2, 1918. Consideration of different types.

Selection of Motors for Shipbuilding Plant (84800). David Elwell. Ills. 1500 w. Elec Wld—March 9, 1918. Conditions influencing individual drive and determination of proper rating. Characteristics of motors for plate-shop machines.

Selection of Steel Mill Auxiliary Motors and Control as Affected by Mechanical Features of the Drive (84770 D). J. D. Wright. Ills. 1500 w. A I E E, Pro—March, 1918. Describes manipulators for blooming mills and their operation, drawing conclusions as to size and types of motor suited for driving.

Some Considerations in Determining the Capacity of Rolling Mill Motors (84771 D). Robert F. Hamilton. 22 pp. A I E E Pro—March, 1918. Details of electric drive, including classification of mills.

Starters

Starters for Squirrel-Cage Induction Motors, and Their Application (84831 A). L. Fokes. Ills. 3000 w. Colly Gdn—Feb. 15, 1918. Considers the auto-transformer method the best.

Synchronous Motors

What Synchronous Motors Can and Cannot Do (85211). Will Brown. Ills. 3000 w. Elec Wld—March 23, 1918. Discussion of industrial applications as viewed from the standpoint of performance alone.

Turbo-Generators

Getting the Most Out of Turbo-Generators (85008). L. H. Parker and J. J. Preble. Ills. 2000 w. Elec Wld—March 16, 1918. Benefits from cleanliness and cooling.

ILLUMINATION

Churches

The Electric Lighting of Ecclesiastical Buildings (85240 N). William Wilson. 6 pp. Instn E E, Jl—March, 1918. Special advantages of electricity; suggestions.

Factories

Changing Aspects of Factory Lighting Legislation (85212). C. E. Clewell. Ills. 2500 w. Elec Wld—March 23, 1918. Serial, 1st part. More elaborate classification of requirements desirable.

Incandescent Lamps

Initial Current Obtained in Incandescent Lamps (84710). C. J. Berry. Ills. 3000 w. Elec Wld—March 2, 1918. Results of investigations on the amount of "overshooting" of the current when metal-filament lamps are thrown in circuit.

Light

See same heading under Electro-Physics.

Mine Lighting

The Safe Operation of Underground Electric Light Systems (84664 A). L. Fokes. Ills. 4500 w. Ir & Cl Trds Rev—Feb. 8, 1918. Important details of mechanical construction and electrical operation.

Portable Lamps

Les Lampes Portatives A Magnéto (85147 B). Ills. 4000 w. L'Industrie Electrique—Feb. 25, 1918. Portable lamp with small magneto generators instead of batteries.

Searchlights

Military Searchlights (85075 B). Roger Haydock. Ills. 2000 w. Prof Mem—March-April, 1918. Development.

Ultraviolet Rays

See same heading under Electro-Physics.

MEASUREMENT

Dielectric Tests

Flexible and Accurate Method for Dielectric Tests (84799). Chester Arthur Butman. Ills. 3500 w. Elec Wld—March 9, 1918. A series-inductance bridge for measuring dielectric energy losses at low frequencies and high potential gradients.

Emf

Simple Method of Measuring Emfs. Accurately (85006). F. Wenner, Paul D. Foote and E. E. Weibel. 1300 w. Elec Wld—March 16, 1918. Applicable to determining temperatures with thermocouples, and other objects.

Heat Losses

Watch Your Radiation Losses to Help Save Coal (85004). Austen Bolam. Ills. 1800 w. Elec Wld—March 16, 1918. Heat losses from uninsulated surfaces. Heat insulation from an investment point.

Inductances

The Measurement of Small Inductances and on Power Losses in Condensers (84656 A). Albert Campbell. Abstract of paper read before the Physical Soc., London. 1600 w. Elec'n—Feb. 8, 1918. Methods, illustrated by examples.

Induction Meters

Adapting Induction Meters to New Frequency (84709). E. L. Fischer. 1800 w. Elec Wld—March 2, 1918. How a company changed its 60-cycle, watt-hour metering equipment to 25-cycle energy, and later back to 60-cycle at minimum expense.

Insulation

Periodical Insulation Tests (84760 A). P. M. Lincoln. 1500 w. Elec Jl—March, 1918. Summary of replies to the question of proper tests.

Line Calculations

Graphical Determination of Line Constants (85005). T. A. Wilkinson. 1500 w. Elec Wld—March 16, 1918. Three charts which assist in the evaluation of the hyperbolic transmission-line formula.

Meters

Testing Watthour Meters (84692). R. L. Mossman. Ills. 1200 w. Pwr Pt Eng—March 1, 1918. Methods and schemes of connections employed.

Economies in Central-Station Meter Testing and Repairing (84702). C. W. Geiger. Ills. 1200 w. Elec Rev, Chi—March 2, 1918. Methods in use by the Los Angeles Power Bureau.

POWER APPLICATIONS

Agriculture

Electro-Culture of Crops (85210). 1400 w. Times Engng Supp—Feb. 22, 1918. The Chester experiments on growth of crops under stimulation of electric discharges.

Electric Ploughing (84643 A). Ills. 2000 w. Elec Rec—Feb. 8, 1918. Serial, 1st part. Based on remarks by M. Delamarre in *Rev. Gen. de l'Elec.* Power requirements; systems of traction; tractors, etc.

Effect of Artificial Light on the Growth and Ripening of Plants (84776 A). J. L. R. Hayden and C. P. Steinmetz. Ills. 1500 w. Gen Elec Rev—March, 1918. Investigations and results.

Cooking

Discussion on "Electrical Cooking as Applied to Large Kitchens" (84823 N). 11500 w. Instn E E, Jl—Feb., 1918. Discussions at Manchester and Yorkshire of W. A. Gillott's paper.

Electric Furnaces

Electric Furnace Installation (85062 A). Thomas Robson Hay. 2500 w. Iron Age—March 21, 1918. Precautions to be observed in promotion work and the selection of the unit.

Elevators

Maintenance of Electric Elevators (85012). Charles W. Naylor. 1800 w. Power—March 19, 1918. Cable and brake troubles, iron vs. steel ropes, need of lubrication, etc.

Garment Making

Electricity in Garment-Making Factories (84758 A). William H. Easton. Ills. 1500 w. Elec Jl—March, 1918. Conditions of the industry, motors for various services, and other electrical appliances.

Pumping

Water Pumping by Electric Power (84949). R. L. Yates. 4000 w. Elec Rev, Chi—March 16, 1918. Serial, 1st part. Characteristics of motor-driven pumps and suggestions for selection.

The Automatic Control of Electrically-Driven Hydraulic Pumps (84848 A). Alfred Towler. Ills. 3500 w. Ir & Cl Trds Rev—Feb. 22, 1918. Abstract of paper before the Leeds Assn. of Elec. Engrs. Automatic controllers in use for starting and stopping electrically driven pressure pumps.

Rolling Mills

Electric Drive in Rolling Mills (85206). 1300 w. Times Engng Supp—Feb. 22, 1918. Increasing use of electric drive in British rolling mills. Abstracted from paper before Manchester Assoc'n Engrs.

Silk Industry

Les Transmissions Électriques Dans L'Industrie De La Soie (85254 B). Ch. Vallet. 3500 w. L'Industrie Électrique—Mar. 10, 1918. Serial, 1st part. Electric drive in the silk industry. General considerations.

Sugar Mills

Operating Features of an Electrically Driven Sugar Mill (84703). F. A. Ortiz. Ills. 1600 w. Elec Rev, Chi—March 2, 1918. Economy results in electrification of Cuban mills.

Electricity in Beet-sugar Factories (84773 A). E. M. Ellis. Ills. 2800 w. Gen Elec Rev—March, 1918. Details of the processes employed showing that economy can be secured by electrification.

TRANSFORMERS

Banking

Shall Transformers Be Banked in a Distributing System? (85191). M. E. Grah. Diagrams. 2000 w. Elec Rev, Chi—March 23, 1918. Effect of banking upon investment, economy and service; precautions, etc.

Capacity

Increasing Transformer Capacity by Circulating Oil (85007). Claude H. Shepherd. Ills. 1200 w. Elec Wld—March 16, 1918. Installation of oil-circulating system at cost of $700 increased permissible loads 60 per cent.

Standardization

The Standardization of Transformers (84655 A). G. Stern, in Electrotech Zeit. (Abstract.) 1700 w. Elecn—Feb. 8, 1918. Points to be considered. Practice in Germany and in the United States.

TRANSMISSION AND DISTRIBUTION

Bus-Bars

Current Capacity of Copper Bus-Bars (84761 A). F. M. Billhimer. 1500 w. Elec Jl—March, 1918. Factors which influence the energy loss in direct and alternating-current conductors.

Cables

Increasing Carrying Capacity of Underground Cable (85214). E. O. Schweitzer. Ills. 1200 w. Elec Wld—March 23, 1918. Benefits from substituting crude vaseline for air in ducts.

Industrial Plants

Standardized Flexible Distributing Systems in Industrial Plants (84772 A). Bassett Jones. Read at meeting of Schenectady Sec. of A. I. E. E. 7500 w. Gen Elec Rev—March, 1918. Serial, 1st part. A system for determining the power requirements of industrial plants in advance of construction.

Insulation

Insulation Under Direct and Alternating Current, Particularly as Regards Moisture (84666 A). Prof. Thornton. Address before N. of Eng. Br. of Assn. of Min. Elec. Engrs. Ills. 1200 w. Ir & Cl Trds Rev—Feb. 8, 1918. The electrical structure of matter, residual charge, breakdown voltage and frequency, etc.

Line Materials

Utilization of Second-Hand Line Materials (84801). L. M. Klauber. Ills. 3500 w. Elec Wld—March 9, 1918. Methods of effecting economies in line construction.

Long Spans

High Voltage Transmission Line Has Mile Span (85217). Romeo Morrissette. Ills. 700 w. Can Engr—March 21, 1918. Overhead power cables under 100,000 volts pressure to cross the St. Lawrence River.

Phase Rotation

Phase Rotation in Relation to Unbalanced Three-Phase Distributing Systems (84906 B). Herbert B. Dwight. 1500 w. Univ Col Jl Eng—Jan., 1918. Problem and solution.

Power Control

The Control of Large Amounts of Power (85091 N). E. B. Wedmore. Ills. 24 pp. Instn E E—March 7, 1918. Considers probable developments of the immediate future, and how conditions may be dealt with.

Power Factor

Étude Des Dispositions A Employer Pour Améliorer Le Facteur De Puissance (85100 D). M. Rechniewski. 2200 w. Bul Soc Internationale Des Électriciens—Jan., 1918. Study of the best methods of improving the power factor on distribution lines.

Regulators

The Voltage Regulator and Phase-balancer Regulator Equipment of the Philadelphia Electric Company (84774 A). R. M. Carothers. Ills. 1500 w. Gen Elec Rev—March, 1918. Installed to distribute over the three phases of the generators a heavy single-phase railway load.

Voltage Regulation of Three-Phase Feeders by Automatically Controlled Induction Regulators (84775 A). M. Unger. Ills. 3500 w. Gen Elec Rev—March, 1918. Regulation by one 3-phase automatic induction regulator.

Switchgear

Switchgear Standardization (85076 N). Charles C. Garrard. Ills. 14 pp. Instn E E—Feb. 21, 1918. General principles underlying standardization, discussing matters in connection.

Underground

Design of Underground Distribution for Electric Light and Power Systems (84769 D). G. J. Newton. Ills. 50 pp. A I E E, Pro—March, 1918. Shows each step necessary in the design of a system for a medium size city.

MISCELLANY

Electrical Industries

Die elektrotechnische Weltindustrie wahrend des Krieges und die zukünftigen Absatzverhältnisse (85102 B). P. Gurewitsch. 5000 w. Bul Schweiz Elektrotechnischer Verein—Jan., 1918. The world's electrical industries in war time and future outlook in Switzerland.

Italy

Electrical Developments in Italy (85244 A). E. Strachan Morgan. 1300 w. Elec Rev—March 8, 1918. Serial, 1st part. Interesting review of progress.

CIVIL ENGINEERING

BRIDGES

Bearings

New Details for Draw Span Bearings (84974). Ills. 900 w. Ry Age—March 15, 1918. Novel features of draw span over the Missouri river at Kansas City.

Bridge Testing

See same heading under Measurement.

Concrete Slabs

Precast Bridge Slabs of Concrete Incased I-Beams (84924). Ills. 2000 w. Eng News-Rec—March 14, 1918. Chicago & Northwestern Railway uses new type of overcrossing.

Double-Deck

Double Deck Railway Bridge Over Kansas River With Thin Floor Construction (84797). F. W. Epps. Ills. 2000 w. Eng News-Rec—March 7, 1918. Details of bridge on new west entrance route.

Draw Bridge

Unusual Failure of a Railroad Draw Bridge (84971). Ills. 900 w. Ry Age—March 15, 1918. Train pushed the span off the pier at one end, causing it to tip down into the river.

Military Bridges

Bridge Training of a Battalion of Mounted Engineers (85071 B). Ills. 2500 w. Prof Mem—March-April, 1918. Report of instruction given in various types of bridges.

Quebec

The Quebec Bridge (84844 A). Ills. 2500 w. Engr—Feb. 15, 1918. Review of the undertaking and its accomplishment.

Viaducts

High-Line Viaduct and Bridge Improve Rail Entrance to Kansas City (84615). F. W. Epps. Map and Ills. 3500 w. Eng News-Rec—Feb. 28, 1918. Details of structures on new route.

CONSTRUCTION

Building Industries

The National Position of the Construction Industry (85182). 2200 w. Eng & Con—March 20, 1918. From address by A. P. Greensfelder, before the Natl. Con. of Builders' Exchanges, Pittsburgh, Pa.

Cantonments

Army Cantonment Construction at Camp Meade, Maryland (85065 B). N. B. Garver. Ills. 15 pp. West Soc Engrs, Jl—Dec., 1917. The general organization, the handling of materials and building erection.

Construction of Cantonment at Camp Grant (85064 B). Charles B. Burdick. Ills. 15 pp. West Soc Engrs, Jl—Dec., 1917. Plan of procedure to make speed possible.

Heating, Cooking and Laundry Equipment of the National Army Cantonments (85066 B). A. C. Willard. Ills. 22 pp. West Soc Engrs, Jl—Dec., 1917. Discussion applying to 16 cantonments.

Contracts

Cost-Plus-Profit Contract Is Commended (85063 A). 1800 w. Iron Age—March 21, 1918. Council of National Defense proposes it with safeguards for large amount of construction work.

A Fair Royalty Contract (85160). Robert G. Pilkington. 1800 w. Am Mach—Feb. 28, 1918. Discussion of royalty contract between employer and employee.

Cofferdams

Methods and Cost of Cofferdam Construction at Oregon City Locks, Willamette River, Oregon (85069 B). E. Burlem Thomson. Ills. 20 pp. Prof-Mem—March-April, 1918. Particularly, methods used in the construction of the concrete division wall.

Concrete Arches

How to Proportion Unsymmetrical Concrete Arches (84617). Joseph P. Schwada. Ills. 1000 w. Eng News-Rec—Feb. 28, 1918. Develops formula for dimensions of ring.

Grain Elevators

Corn Production Stimulated in South by Construction of Small-Capacity Elevators (84777). Chauncey Smith. Ills. 1600 w. Mfrs' Rec—March 7, 1918.

Housing

Industrial Housing (84989 B). H. Walter Forster, with discussion. 33 pp. Engrs' Soc W Penn, Pro—Dec., 1917. Present shortage in housing, type needed, cost, etc.

Industrial Housing Developments in America (84871 A). Lawrence Veiller. Ills. 3000 w. Arch Rec—March, 1918. Serial, 1st part. Present article deals with "Eclipse Park," Beloit, Wis.

The Housing Problem (85061 A). W. E. Freeland. Ills. 4000 w. Iron Age—March 21, 1918. Accomplishments of the Bridgeport Housing Co., showing what the owner of a city factory can do.

Tunnels

Multiple-Air-Chamber Shield for Large Tunnels (85096). John F. O'-Rourke. Ills. 2500 w. Eng News-Rec—March 21, 1918. Face divided into tiers of pockets to carry different air pressures.

War Hospitals

Our War Hospitals in France (84,-872 A). Edward F. Stevens. Ills. and Plans. 1800 w Arch Rec—March, 1918. Brief description of approved plans.

IRRIGATION AND RECLAMATION

Agriculture

Determination of the Duty of Water by Analytical Experiment (84943 D). W. C. Hammatt. Ills. 50 pp. A S C E, Pro—Feb., 1918. Methods used in determining the quantity of water required for the growth of certain crops.

California

The West Side Irrigation District (84857). Ills. 3300 w. West Eng—March, 1918. A district comprising about 11500 acres near Tracy, Calif.

Flumes

Reinforced-Concrete Flumes Poured in 100-Foot Lengths (85097). Ills. 600 w. Eng News-Rec—March 21, 1918. Hub and spigot expansion joints in six irrigation conduits have been in service two years.

Land Improvement

Engineering Work and Food Supply (84929). F. H. Newell. From address before Am Soc of Ag. Engrs. 1800 w. Eng & Con—March 13, 1918. Great possibilities of irrigation and drainage.

MATERIALS OF CONSTRUCTION

Building Materials

Building Materials (85201). 2000 w. Times Engng Supp—Feb. 22, 1918. Formation of a Research Committee of British Dept. of Scientific and Industrial Research for investigation of building materials.

Cement

Fabrique De Ciment Portland (85,-124 B). Ills. 2500 w. Le Génie Civil—Feb. 2, 1918. French establishment making Portland cement near Marseilles.

Cement Works

Description of the Works of White's South African Cement Company, Limited (84982 N). H. Campbell, with discussion. 7500 w. So Af Inst Engrs, Jl—Jan., 1918. Works at Ventersburg Road, Orang Free State.

Ceramics

Ceramics and the War (84723 A). Edward W. Washburn. 2500 w. Met & Chem Eng—March 1, 1918. Problems confronting the country in the field of ceramics.

Fertilizers

Fertilizers (84981 N). Allan Baguley, with discussion. 12 pp. Chem, Met & Min Soc of S. Af., Jl—Nov., 1917. How to increase the productive power of the soil.

Fireproofing

Report of Committee C-5 on Fireproofing (85080 N). 16 pp. Am Soc Test Mats, Pro—June, 1917. Report of tests, with discussion.

Hollow Tile

Report of Committee C-10 on Hollow Building Tile (85082 N). 28 pp. Am Soc Test Mats, Pro—June, 1917. Organization, scope of work, and progress made.

Hydraulic Cement

Hydraulische Mortelmaterialen (85,-148 B). A. E. Dinger. Ills. 10,000 w. Ingenieur—Feb. 9, 1918. History, constitution and applications of hydraulic cements.

Lime
The Valuation of Lime for Various Purposes (84765 B). Richard K. Meade. 4000 w. Jl Ind & Eng Chem—March, 1918. Outlines methods generally employed for chemical analysis of lime.

Lime Plant
Features of Modern Lime Plant at Kingsport, Tennessee (84778). Ills. 1500 w. Mfrs' Rec—March 7, 1918. Detailed description.

Lubricants
Report of Committee D-2 on Lubricants (85083 N). 8 pp. Am Soc Test Mats, Pro—June, 1917. Report of continued work on tests.

Nomenclature
Report on British Standard Nomenclature of Bituminous Materials (85084 N). 6 pp. Am Soc Test Mats, Pro—June, 1917. Definitions, remarks, etc.

Portland Cement
Properties of Portland Cement Having a High Magnesia Content (84873). P. H. Bates. Ills. 40 pp. U. S. Bur Stds, Tech paper 102—Jan. 19, 1918. Investigation to determine the effects of increasing the magnesia content.

Reinforced Concrete
A New System of Reinforcement, and Some Uses of Concrete and Cement in Mining (84935 N). W. Marriott, with discussion. 3000 w. Instn Min Engrs, Trans—Jan., 1918. Deals with reinforced-concrete pit-props and bars and the uses of concrete and cement in mining.

Report of Committee C-2 on Reinforced Concrete (85079 N). 92 pp. Am Soc Test Mats, Pro—June, 1917. Final report on concrete and reinforced concrete with discussion.

Sewer Pipe
Vitrified Clay Sewer Pipe (84686). A. R. Duff. 2000 w. Can Engr—Feb. 28, 1918. Abstract from 1916 Report of the Provincial Board of Health, Ontario.

Silica Brick
The Manufacture of Silica Bricks (84837 A). H. Le Chatelier and B. Bogitch, in *Comptes Rendus*. 1500 w. Colly Gdn—Feb. 22, 1918. Study of the physical and chemical constitution.

Wood Preservation
Report of Committee XVII—On Wood Preservation (85034 C). 16 pp. Am Ry Eng Assn, Bul—March, 1918. With experiments and notes by W. H. Courtenay and by S. R. Church.

MEASUREMENT

Beams
Influence Lines for Continuous Beams (84838 A). G. R. Magnel. Ills. 2000 w. Engng—Feb. 15, 1918. States the problem and explains how it can be solved with theoretical accuracy in a few minutes.

Bridge Testing
On the Testing of Metallic Bridges (84668 A). Ills. 3000 w. Ry Engr—Feb., 1918. Serial, 1st part. Translated from Prof. Jules Gaudard's work entitled "Croquis de Ponts Metalliques."

Piles
The Resistance of a Group of Piles (85067 B). H. M. Westergaard. Ills. 10 pp. West Soc Engrs, Jl—Dec., 1917. A method of determining the distribution of pressure among any irregular group of piles.

MUNICIPAL

Garbage
New York City has Largest and Best Garbage-Reduction Works (85095). Ills. 2500 w. Eng News-Rec—March 21, 1918. Details of plant with capacity of 1500 tons a day.

Recommended Garbage and Rubbish Disposal Methods for Baltimore, Md. (84932). 1000 w. Eng & Con—March 13, 1918. Methods recommended by Walter E. Lee.

Imhoff Tanks
Experiences in Six Years' Operation of Imhoff Tanks (84931). 2200 w. Eng & Con—March 13, 1918. From paper by Paul Molitor before the N. J. Sewage Works Assn.

Summary of Operating Experiences with Imhoff Tanks (84927). 1200 w. Eng & Con—March 13, 1918. From paper by George W. Fuller, before N. J. Sewage Works Assn.

Pumping
The City of Peterborough Municipal Pumping Station (84742). H. R. Armstrong. Ills. 2500 w. Pr House—Feb., 1918. Efficient plant and excellent service.

Sewage
Some Characteristic Design Features of the Northeast Sewage Treatment Works at Philadelphia (84735 A). W. L. Stevenson. Ills. 900 w. Mun Eng—March, 1918. Imhoff tank installation designed to care for the sewage of 300,000 people.

Sewerage
Construction Plant and Methods Employed on Recent Important Sewerage Work in Illinois (84727 A). Ills. 2000 w. Mun Eng—March, 1918. Data from report of sub-committee of Ills. Soc. of Engrs. on important work during 1917.

Sewers
Considerations Affecting the Choice Between the Separate and Combined Sewer Systems (84728 A). Paul E. Green. 1000 w. Mun Eng—March, 1918. Conditions governing selection of type.

Les Rivières De Paris (85115 B). P. Chevolot. Ills. 1600 w. La Nature—Feb. 2, 1918. General layout and interconnection of sewers in Paris.

ROADS AND PAVEMENTS

Alaska
Methods of Constructing Wagon Roads in Alaska (84784). 2000 w. Eng & Con—March 6, 1918. From annual report of the Board of Road Commissioners, describing unusual conditions.

Bitumens
Bitumens Used in Road Building (84908 B). Jerome S. Marcus. 1500 w. Univ Col Jl Eng—Jan., 1918. Specifications of tars for different purposes.

Concrete
Concrete Roads for Trucks (84869 A). Ills. 2500 w. Com Vhle—March 1, 1918. Methods of construction.

Discussion on "Concrete Roads as a Solution of Our National Transportation Problem; Their Construction, Maintenance, and Development" (84910 A). Carl Gayler. 800 w. E Cb St L, Jl—Jan.-Feb., 1918. Discussion of Mr. Fisk's paper.

Essentials of Good Practice in the Construction of Concrete Roads (84731 A). Edwin K. Borchard. 1800 w. Mun Eng—March, 1918. Details of construction.

First Frost Is Never Responsible for Cracked Concrete Roadways (84618). J. L. Harrison. Ills. 2000 w. Eng News-Rec—Feb. 28, 1918. Damage traced to freezing which follows a thaw.

Dust Prevention
Progress Reports of Experiments in Dust Prevention and Road Preservation, 1916 (84879). 98 pp. U S Dept Ag, No. 586—Feb. 28, 1918.

Earth Roads
Maintenance of Earth Roads (84955). John H. Mullen, at Richmond, Va. Ills. 1800 w. Br Rds & Sts—March, 1918. Organization and personal responsibility important.

Highways
Improper Drainage the Cause of Most Highway Failures (85092). A. A. Young. Ills. 4000 w. Eng News-Rec—March 21, 1918. Considers that no hard surface should be constructed until entire road has been under maintenance long enough to show weak spots.

Preliminary Work on Provincial Highways (85000). George Hogarth. Ills. 1800 w. Can Engr—March 14 1918. Work on the Kingston road, Ontario.

Maintenance
Road Maintenance and Repair (84688). Alexander W. Graham. Read before Am Road Bldrs. Assn. 2500 w. Can Engr—Feb. 28, 1918. Problems encountered in Missouri.

Military Roads
Military Road Conditions of the War Zone in France (85274 A). William J. Weir. 4500 w. Worc Poly Inst—March, 1918.

Ontario
Road Development in Ontario (84689). C. R. Wheelock. Read before Assn. of Ontario Land Surveyors. 2500 w. Can Engr—Feb. 28, 1918. History of development.

Paving
Street Paving at Boulder, Colorado (84905 B). H. E. Phelps. Plan. 2500 w. Univ Col Jl Eng—Jan., 1918. Details of design and construction.

Pavements
Bituminous Pavements, Adaptable to Various Conditions, With Special Reference to Type and Thickness (8473 A). L. Kirschbraun. Ills. 3500 w. Mun Eng—March, 1918. Discussion of bituminous pavements employed in high-grade construction.

Recent Developments in the Construction of Bituminous and Concrete Pavements (84782). Charles M. Upham. Abstract of paper before Am. Road Bldrs. Assn. 3500 w. Eng & Con—March 6, 1918. Summary of recent work.

Road Building
Methods of Constructing Roads at Northeastern Cantonments of National Army (84781). Ills. 1800 w. Eng & Con—March 6, 1918. From paper by Philip P. Sharples before Am. Road Bldrs. Assn. Bituminous concrete used at three cantonments.

Surfacing
Efficiency of the Application of Bituminous Materials for Surface Treatments on Gravel and Broken Stone Roads (84783). Julius Adler. From paper before Am. Assn. for Adv. of Sci. 2500 w. Eng & Con—March 6, 1918. On selection of materials and methods.

War Roads
Pennsylvania War Road Example (85187). R. H. Johnston. Ills. 1500 w. Auto Ind—March 21, 1918. Snow removal reduces annual maintenance.

Wet Subgrades
Subsurface Water and Its Relation to Pavement Troubles (84780). J. L. Harrison. 3000 w. Eng & Con—March 6, 1918. Outlines the problem.

Wood Block
Causes of Expansion Trouble in Wood Block Pavements in Texas Cities (84779). Ills. 1200 w. Eng & Con—March 6, 1918. Information from C. H. Teesdale's paper.

WATER SUPPLY

Chicago

What Becomes of the Water Pumped in Chicago (84933). 3000 w. Eng & Con—March 13, 1918. From report of Chicago Bureau of Public Efficiency.

Chlorination

Results of the Chlorination of Public Water Supplies in Michigan (84736 A). Edward D. Rich. 2000 w. Mun Eng—March, 1918. Information from Eng. Bul. No. 10 of the Mich. State Bd. of Health. Conditions where successful; and also its limitations.

Consumption

Measures Adopted to Curtail Water Consumption in the City of St. Louis (84733 A). Edward E. Wall. 1600 w. Mun Eng—March, 1918. Meterage the only way to lower consumption.

Dams

High Multiple-Arch Concrete Dam for Salt Lake City Water-Supply (84795). Ills. 1200 w. Eng News-Rec—March 7, 1918. Cost $100 per acre-foot of storage.

Large Taintor and Sector Gates of the Middle Falls Dam at Rochester (84902 A). Edgar R. Crofts. Ills. 3500 w. Corn C E—Jan., 1918. Novel features of a new hydro-electric development, particularly the movable dam and gates built for it.

Filtration

Reduction of Free Carbonic Acid in Settled Water Increases Length of Filter Runs at Panama (84928). 2000 w. Eng & Con—March 13, 1918. Information from report of George C. Bunker on the operation of these plants.

Water Filtration Plant at St. Hyacinthe, P. Q. (84999). Frederick Elbert Field. Ills. 2000 w. Can Engr—March 14, 1918. Four units, each of 1,000,000-gallons daily capacity.

Gardens

Features of Overhead Irrigation Systems in Small Gardens Within Reach of City Water Works Plants (84734 A). W. H. Coles. 1300 w. Mun Eng—March, 1918. Story of the development of overhead irrigation.

Havana

El Problema Del Agua En La Habana (85103 A). J. Primelles. Ills. 6000 w. Rev Soc Cubana De Ingenieros—Feb., 1918. Water supply for Havana. Construction work and design of reservoirs and aqueduct.

Meters

Popular Objections to Water Metering and How to Overcome Them (84930). 2000 w. Eng & Con—March 13, 1918. From recent report of the Chicago Bureau of Public Efficiency.

New York

New York City's Catskill Mountain Water Supply (84854 A). Alfred D. Flinn. Map of Ills. 17 pp. E Cb Phil, Jl—March, 1918. Before Worcester Tech. Club. Outline of the system, types of structures, reservoirs, etc.

Pipe Lines

New Trunk Main Between Burrator and Roborough Reservoirs (84678 A). Ills. 700 w. Engr—Feb. 8, 1918. New pipe line for the Plymouth Corporation Waterworks, having inside diameter of 33 in.

Purification

Filter Alums Used in Ontario (85218). G. E. Gallinger. A. V. De Laporte, and F. A. Dallyn. 1500 w. Can Engr—March 21, 1918. From annual report of the Provincial Board of Health. Analyses and estimates, etc.

Tanks

The Range of Results Obtainable in the Use of Concrete in Water Tank Construction (84729 A). C. C. Whitaker. Ills. 2500 w. Mun Eng—March, 1918. Applications of reinforced concrete to artistic architectural effect.

Waltham Water Works

How a Deficite of $2000 was Changed to a Surplus of $27000 in One Year at the Waltham Water Works (84732 A). Bertram Brewer. Ills. 2000 w. Mun Eng—March, 1918. Brought about by introduction of business like methods.

WATERWAYS AND HARBORS

Bank Revetment

Concrete Paved Bank Revetment, Missouri River Improvement (85068 B). G. C. Haydon. Ills. 14 pp. Prof Mem—March-April, 1918. Details of this type of protection, and the cost.

Barge Canal

The Canal as a Carrier of Coal (84704). W. W. Wotherspoon. Map. 4000 w. Cl Age—March 2, 1918. Survey of the commercial possibilities of transportation of coal consumed in New York State.

Canada

Improvements to Canadian Harbors (85129). 1300 w. Naut Gaz—Jan. 31, 1918. Report of Dominion Royal Commission on improvements on the St. Lawrence and various harbors.

Canal Lock

Construction De L'Écluse De Hausweert (85123 B). A. Bijls. Ills. 6000 w. Le Génie Civil—Feb. 2, 1918. Construction of large lock on the Zuid-Beveland Canal, Belgium.

Canals

Canals As Coal Carriers (85128). 2200 w. Nautical Gaz—Jan. 17, 1918. Suggestion by W. W. Wocherspoon, for relieving railway freight congestion by use of all existing canals.

French Ports

Les Ports Français Et La Guerre (85255 B). A. Pawlowski. Ills. 6800 w. Le Génie Civil—March 9, 1918. Harbors and docks of West Algerian ports described.

Considérations Sur Le Port De Paris (85127 B). M. Jacquinot. Ills. 2500 w. Le Génie Civil—Feb. 16, 1918. Project for a canal 14 miles long, to connect the Seine and Oise rivers.

Cette, Port Franco-Suisse (85119 B). A. Pawlowski. Ills. 1200 w. La Nature—Feb. 9, 1918. Harbor and dock facilities of Cette, on the south coast of France.

Madras

Madras Harbour (85208). 1300 w. Times Engng Supp—Feb. 22, 1918. Construction of the West Quay, nearly 3000 ft. long, at Madras.

Newcastle, N. S. W.

Newcastle Harbor Improvements, N. S. W. (84998 N). Ills. 2500 w. Comwh Engr—Feb. 1, 1918. Providing for industrial development.

Scotland

Mid-Scotland Ship Canal (85266 A). 1500 w. Engr—March 1, 1918. Commercial aspects of the schemes; industrial developments, etc.

MISCELLANY

Engineers

Address at the Annual Meeting, January 16th, 1918 (84944 D). George H. Pegram. 3000 w. A S C E, Pro—Feb., 1918. Presidential address. Public service of engineers.

Explosions

Zones of Silence in Sound Areas from Explosions (85074 B). Charles E. Munroe. Ills. 2500 w. Prof Mem—March-April, 1918. Testimony showing the erratic behavior of sound.

Warfare

The War on Land and Sea (84855 A). William L. Cathcart. Ills. 16 pp. E Cb Phila, Jl—March, 1918. Review of important points.

MARINE AND NAVAL ENGINEERING

Balancing

Dynamic Balancing (85040 F). F. J. Cleary. Ills. and Plates. 35 pp. Am Soc Nav Engrs, Jl—Feb., 1918. Detailed description of method developed and used at Mare Island for dynamically balancing the rotating elements of the turbine propelling machinery U. S. S. "Shaw."

British Columbia

British Columbia's Ships (85130). 1700 w. Naut Gaz—Feb. 28, 1918. Detailed specifications for wooden ships now building in British Columbia Yards.

Car Transports

Seagoing Car Transports (85137). Ills. 2200 w. Naut Gaz—Feb. 28, 1918. Designs for fast seagoing car transports for use on the coast or Great Lakes.

Coal Pier

New Reading Coal Pier Has Interesting Features (85152). Ills. 1500 w. Ry Age—March 22, 1918. Modern car unloading machine doubles capacity of Port Reading (N. J.) terminal.

Concrete Ships

Building Concrete Ships (85134). Ills. 2400 w. Naut Gaz—Feb. 7, 1918. Advantages and disadvantages.

Convoy System

Allied Convoy System (85252). 900 w. Ills. Naut Gaz—March 21, 1918. Abstract of article in Amsterdam *Algemeen Handelsblad* giving alleged system of arrangement for escorting merchantmen through the war zone.

Electric Propulsion

Electric Marine Propulsion (85202). 3000 w. Times Engng Supp—Feb. 22, 1918. Various questions of design.

Evaporator

Test of Reilly Multicoil Evaporator (Submerged Type) (85043 F). H. T. Dyer. Ills. 20 pp. Am Soc Nav Engrs, Jl—Feb., 1918. Tests with results and general conclusions deduced from them.

Test of Regenerative Evaporating Apparatus (85041 F). M. C. Stuart. Ills. 18 pp. Am Soc Nav Engrs, Jl—Feb., 1918. Details of a patented system, giving results of test, and calculations for the performance and for the installation.

Flow

Lateral Flow of Water Under Low Heads (85042 F). Albert E. Guy Ills. 18 pp. Am Soc Nav Engrs, Jl—Feb., 1918. Deals with the question of head causing the flow through a lateral orifice

Germany

German Ship Sub[illegible] (85135). 3500 w. Naut Gaz—Feb. 7, 1918. History and text of recent ship subsidy bill.

Lake Navigation

Lake Records Fall Despite Delays (84023). Wm. Livingstone. 3500 w. Mar Rev—March, 1918. Obstacles to navigation during 1917, shipments, etc.

" Maine "

A Midshipman on the Maine (84,986 A). W. T. Cluverius. Ills. 12 pp. U S Nav Inst, Pro—Feb., 1918. Record written only a few months after the ship's destruction.

Marine Lighting

Recent Developments in Marine Lighting (84845 A). 3000 w. Engr—Feb. 22, 1918. Serial, 1st part. Illumination of lighthouses, lightships, etc.

Oil Fuel

Oil As Fuel for Marine Craft (85136). 2300 w. Naut Gaz—Feb. 7, 1918. Increasing use of oil for marine purposes. Supply from Mexican sources.

Oil Tanker

Oil Tanker of 10,000 Tons Deadweight Adopted as Standard by shipping Board (84738 A). Ills. 2500 w. Int Mar Eng—March, 1918. Details of steamer designed by Sun Shipbuilding Co.

Ordnance

British and German Naval Ordnance (84673 A). 3000 w. Engr—Feb. 1, 1918. Serial, 1st part. Naval gunnery and ordnance development.

Progress

Progress in Marine Engineering (85,200). 1600 w. Times Engng Supp—Feb. 22, 1918. Progress reported by North East Coast Shipbuilders. Standard ship designs.

Propulsion

Propulsion of Ships (84991 B). Eskil Berg. Ills. 16 pp. Fkn Inst, Jl—March, 1918. Latest developments in marine propulsion.

Refrigeration

L'Installation Frigorifique du Navire Italien "Resurrezione" (85143 B). C. Dantin. Ills. 2600 w. Le Génie Civil—March 2, 1918. Refrigerating plant on Italian steamer trading with South American ports.

Reinforced Concrete

Ships of Reinforced Concrete (84830 A). 3500 w. Eng Rev—Feb. 15, 1918. Serial, 1st part. Its value as a shipbuilding material.

Riveting

Efficient Ship Riveting (85138). J. R. Oldham. Ills. 1800 w. Naut Gaz—Feb. 28, 1918. Best method of riveting up steel ship plates.

Salvage

Ingenious Solution of Difficult Salvage Problem (85270). Ills. 1400 w. Com Air Mag—March, 1918. Account of the salvage of the German tanker "Gut Heil," at Baton Rouge.

Shipbuilding

Training Shipyard Workers (85166). James A. Pratt. 2500 w. Am Mach—March 7, 1918. Methods used in training men for work on fabricated steel.

Ship Labor

Ship Labor Under the Microscope (84622 A). Map. 4000 w. Mar Rev—March, 1918. Opinions of experts before the Senate committee on the problem of manpower.

Shipyards

Facts About the Hog Island Yard (84624 A). George J. Baldwin. 2500 w. Mar Rev—March, 1918. Address by Chairman of Am. International Shipbuilding Corporation before Phila. Chamber of Commerce.

State Control

See same heading under Industrial Management, *Regulation.*

Steel Ships

Cast Steel Ship Construction (85,133). Ills. 1200 w. Naut Gaz—Feb. 7, 1918. Cast steel and welded steel.

Submarines

La Lutte Contre Les Sous-Marins Et Les Inventeurs (85121 B). H. Volta. Ills. 4200 w. La Nature—Feb. 23, 1918. Devices for intercepting and destroying submarines. Recent inventions.

Eight Months of U-Boat Warfare (84739 A). Leonard M. Passano. 1500 w. Int Mar Eng—March, 1918. Evasion proves best defense against submarines.

Offensive Against the Submarine (84642 A). Joseph A. Steinmetz. 4500 w. A S M E, Jl—March, 1918. With annotations to the suggestions to inventors made by the U. S. Naval Consulting Board regarding the submarine and kindred problems.

Silver Linings to the Submarine Piracy (84744). George S. Laing. 2500 w. Mar Eng, Can—Jan., 1918. Lessons that have been learned from submarine warfare.

La Protection Des Navires Contre Les Sous-Marins (85253). H. Volta. Ills. 3200 w. La Nature—March 9, 1918. Protection against U boats. Camouflage, smoke screens and suggested devices of various kinds.

Terminals

Post Terminals for War Transportation Being Built (84796). Ills. 1700 w. Eng News-Rec—March 7, 1918. Details of increased facilities being provided.

Unsinkable Ships

Unsinkable Ship Plans (85250). 1000 w. Naut Gaz—March 7, 1918. Consideration of various plans that have been proposed. Opinions of experts on the Donnelly and the Niles plans.

Wooden Ships

New Type Wooden Ship (85251). 1800 w. Ills. Naut Gaz—March 7, 1918. The "War Mystery," largest wooden steamship ever built, launched recently.

MINING AND METALLURGY

BASE METALLURGY

Copper

Mount Mudlo Copper Mine, Kilkivan (85229 N). E. Cecil Saint-Smith. 1500 w. Qnsd Gov Min Jl—Feb., 1918. Ore occurrence.

Quelques Progrès Récents En Metallurgie Du Cuivre (85145 B). L. Guillet. 2300 w. La Nature—March 2, 1918. Recent progress in copper smelting and refining.

Spelter

The British Spelter Industry (84839 A). 3000 w. Engng—Feb. 15, 1918. Serial, 1st part. Position of England with reference to spelter; what zinc plants have to do; and how to supply the needs of the country.

Zinc

Electrolytic Zinc (84961 D). C. A. Hansen. 29 pp. A I M E, Bul—March, 1918. Power characteristics, impurities in zinc electrolyte, and other data based on experiments.

The Kansas-Oklahoma-Missouri, or Komspelter Zinc Region (84714). T. A. Rickard. Map & Ills. 4000 w. Min & Sci Pr—March 2, 1918. Serial, 1st part. Output of zinc-lead concentrate.

COAL AND COKE

Breakers

The Mineral Spring Breaker (84951). Dever C. Ashmead. Ills. 2500 w. Cl Age—March 16, 1918. Wilkes-Barre, Pa.

Carbonization

Carbonization of Illinois Coals in Inclined Gas Retorts (85039 N). F. K. Ovitz. 18 pp. Ill. Geol Surv—Bul. 20. Description and discussion of tests.

Coal

Coal Thrift (84856 A). 2500 w. E Cb Phila, Jl—March, 1918. Suggestions of "Committee on Fuel Conservation of Engineers' Club, Phila.

Coal Analysis

Sur Le Dosage Du Carbone Total Dans Les Combustibles (85113 C + D). E. Damour and M. De La Morinière. Ills. 5600 w. Revue De Métallurgie—Nov.-Dec., 1917. Determination of total carbon content of combustibles, and its economic importance.

Coal Economy

Coal Economy from a National Standpoint (84835 A). W. H. Casmey. 4000 w. Colly Gdn—Feb. 15, 1918. From paper before Manchester Geol. & Min. Soc. Indicates present waste and suggests remedies.

Coal Problem

The Coal Problem (84853). E. G. Bailey. Lecture at Johns Hopkins University. 6000 w. Power—March 12, 1918. Impurities in coal.

Coal Sales

Revised Directions as to the Sale of Coal (84672 A). 7000 w. Colly Gdn—Feb. 8, 1918. Alterations made in Directions dated Oct. 12, 1917.

Coal Saving

Coal Saving at Collieries by Economical Steam Raising (85258 A). D. Brownlie. 4400 w. Colly Gdn—March 1, 1918. Discusses possible improvements in the economical generation of steam.

Coal Supply

See same heading under ELECTRICAL ENGINEERING, *Generating Stations.*

Coke Ovens

The Byproduct Coke Oven and Its Products (84960 D). William Hutton Blauvelt. Ills. 18 pp. A I M E, Bul—March, 1918. Discussion of the development.

Coking Coals

The Occurrence of Coking Coals in Scotland (84832 A). Robert W. Dron. From a paper before the Min. Inst. of Scotland. 1400 w. Colly Gdn—Feb. 15, 1918. Results of extensive investigations.

Conservation

Coal Conservation (84813). David Moffat Myers. Ills. 3000 w. Cl Age—March 9, 1918. On use without waste: true conservation.

Culm

The Utilization of Anthracite Culm (84812). M. S. Hachita. Ills. 3500 w. Cl Age—March 9, 1918. Results obtained by a mixture of culm and bituminous coal.

Fuel

Canada's Fuel Problem (84687) Joseph E. Armstrong. 3500 w. Can Engr—Feb. 28, 1918. Address in the Ontario House of Commons. Information concerning deposits of coal in Canada.

The Missouri Fuel Situation (84886). Wallace Crossley, with discussion. 4000 w. St L Ry Cb, Pro—Feb. 15, 1918. Need of co-ordination.

Fuel Shortage

Several Phases of the Fuel Shortage (84639). George F. Weaton. 1800 w. Natl Engr—March, 1918. Getting along with fuel shortage in industrial plants.

Low Grade Fuels

Les Mauvais Combustibles (85114 B). L. Renié. Ills. 2700 w. La Nature—Jan. 26, 1918. Treatment of inferior grades of fuel. Coal washing systems.

Methods

A Plea for the Examination of Methods and for Greater Efficiency (84849 A). Robert Wilson. Read before Natl. Assn. of Colly. Mgrs. 4500 w. Ir & Cl Trds Rev—Feb. 22, 1918. Points deserving attention in coal mining.

Moisture

The Moisture Content of Some Typical Coals (84891 B). G. A. Hulett, E. Mack, and C. P. Smyth. Ills. 2500 w. Am Jl Sci—March, 1918. Detailed study of typical coals.

Pillar Robbing

Importance of Proper Robbing Methods (84953). J. T. Morris. Ills. 1000 w. Cl Age—March 16, 1918. Importance of the question of pillars.

Powdered Coal

See same heading under MECHANICAL ENGINEERING, *Steam Engineering*.

Prices

Maximum House Coal Prices in the Metropolitan Area (85260 A). 3500 w. Colly Gdn—March 1, 1918. Rules for determining prices.

Rates

British and Foreign Coal Rates (84,-663 A). Granville F. Bilbrough. 6000 w. Ir & Cl Trds Rev—Feb. 8, 1908. Serial, 1st part. Comparison and discussion of rates in different countries.

Thin Seams

Discussion of Mr. George Gibb's Paper on "A Fresh Aspect of Intensive Mining Thin Seams" (84938 N). 1300 w. Instn Min Engrs, Trans—Jan., 1918.

The Thin Coal Seams of Eastern Canada (84661 A). Ills. 3000 w. Engng—Feb. 8, 1918. Reviews monograph by I. F. Kellock Brown, issued by the Can. Dept. of Mines.

GEOLOGY

Alum

On the Occurrence of Natural Alum, etc., at Boonmoo Pinnacle, North Queensland (85227 N). E. Cecil Saint-Smith. Ills. 1000 w. Qnsd Gov Min Jl—Feb. 15, 1918 Of no commercial importance.

Idaho

An Old Erosion Surface in Idaho: Is It Eocene? (85057 B) John L. Rich. Sketch map. 16 pp. Econ Geol—March, 1918. Examination to determine the age.

Mineral Resources

The Constitution and Work of the Imperial Institute, With Special Reference to Mineral Resources (85037 N). 19 pp. Imp Inst, Bul—July-Sept., 1917. Investigations.

Ore Deposits

Further Remarks on the Ores of Engels, California (85053 B). L. C. Graton and D. H. McLaughlin. 18 pp. Econ Geol—March, 1918. Study of secondary enrichment.

Petroleum

The Geology of Petroleum Deposits (85045 A). C. C. O'Harra. Maps and Ills. 20 pp. Pahasapa Qr—Feb., 1918. Theories and studies of oil and gas deposits.

Queensland

Geological Notes on the Kin Kin (85228 N). Lionel C. Ball. Ills. 3000 w. Qnsd Gov Min Jl—Feb., 1918. General geology.

Notes on the Geology of Parts of Gladstone District (84695 N). H. I. Jensen. Maps. 2500 w. Qnsd Gov Min Jl—Jan., 1918. Observations on the geology and ore deposits.

United States

The Mineral Industries of the United States (84875). Part I. Coal Products: An Object Lesson in Resource Administration. Chester G. Gilbert. Ills. and Map. 14 pp. U S Natl Museum—Bul. 102, Part I.

Utah

The East Tintic District, Utah (84811). Benjamin F. Tibby. Ills. 1500 w. Min & Sci Pr—March 9, 1918. Geology of the deposits of sulphide and oxidized ore.

IRON AND STEEL

Analysis

Méthode De Dosage Rapide Du Manganèse Et Du Chrome (85112 C — D). A. Travers. 6000 w. Revue De Métallurgie—Nov.-Dec., 1917. Rapid determination of manganese and chromium in steel.

Brazil

Les Minerais De Fer Du Brésil (85111 C — D). F. De Souza-Dantas. 4000 w. Revue De Métallurgie—Nov.-Dec., 1917. Iron ores of Brazil, blast furnaces and steel works.

Canada

Iron Ore Occurrences in Canada (85267 N). E. Lindeman and L. L. Bolton. Ills. and Maps. Vol. II. Descriptions of Iron Ore Occurrences. 200 pp. Can Dept Mines—No. 217.

Electrometallurgy

Pig-Iron from Scrap-Steel (84859). Ills. 1200 w. West Eng—March, 1918. About 50 tons of pig-iron is produced per day in electric furnaces at Watervliet, N. Y.

France

Les Hauts Fourneaux De Caen (85120 B). A. Pawlowski. Ills. 2900 w. La Nature Feb. 16, 1918. Blast furnaces and steel plates at Caen, northwestern France.

Furnaces

Electric Steel Refining Furnaces (84847 A). James Bibby. Ills. 4500 w. Ir & Cl Trds Rev—Feb. 15, 1918. Read before the Faraday Soc. Their advantages. The metallurgical requirements for refining, etc.

Gas Furnaces

Gas Furnaces as Re-Heaters of Iron Piles, etc. (84667 A). George Carrington. Abstract of paper read before Staffordshire Ir. & St Inst. 3000 w. Ir & Cl Trds Rev—Feb. 8, 1918. Features of the gas furnace as compared with the coal-fired reverberatory furnace, favoring the latter. Short discussion.

Germany

L'Approvisiounement De L'Allemagne (85125 B). J. T. Laspière. 5100 w. Le Génie Civil—Feb. 9, 1918. Serial, 1st part. The iron ore resources of Germany. Charts of pre-war production, etc

Heat Treatment

Application of Heat in Steel Treating (84755 A). A. F. MacFarland. Ills. 2500 w. Iron Age—March 7, 1918. Principles of generation by electricity, gas, oil, or powdered coal

India

The Tata Iron and Steel Works: Their Origin and Development (85035 A). H. M. Surtees Tuckwell, with discussion. Ills. 15 pp. Roy Soc Arts, Jl—Feb. 1, 1918. Origin and development of these works and the effect upon the industrial prosperity of India.

Limonite

The Limonite Deposits of Mayaguez, Porto Rico (84965 D). Charles R. Fettke and Bela Hubbard. Ills. 16 pp. A I M E, Bul—March, 1918. Physiography and geology, character of the ore, origin, etc.

Mesabi

The Mesabi Iron Range (85049 B). Frank B. Walker. Ills. 15 pp. Bos Soc C E, Pro—March, 1918. Account of the mines and ore docks.

Spain

Iron and Coal in Spain After the War (84665 A). 2500 w. Ir & Cl Trds Rev—Feb. 8, 1918. Information from articles by Señor Don Julio de Lazúrtequi.

Steel

Molybdenum, Tungsten and Bismuth (84995 A). 2000 w. Aus Min Stan—Feb. 7, 1918. Serial, 1st part. The present article is a preface to a proposed treatise on these metals and compounds.

Steel Treating

Principles of the Generation and Application of Heat in Steel Treating (84865 A). A. F. MacFarland. Abstract of paper before Chicago Sec. of Steel Treating Research Soc. 1500 w. Ry Mech Engr—March, 1918. Fundamental principles involved as exemplified in some of the methods in use.

MINE OPERATION

Cement Gun

Cement Gun in Mining Work (84952). George S. Rice. Ills. 3500 w. Cl Age—March 16, 1918. Serial, 1st part. Early use of concrete and cement grout in mines and the introduction of the cement gun. Its operation and results.

Conveyors

Underground Conveyors (84671 A). Harold C. Jenkins. Ills. Read before Midland Inst. of Min., Civ., & Mech. Engrs. 4000 w. Colly Gdn—Feb. 8, 1918. Types in use, their installation, etc.

Manitoba

Mining in Northern Manitoba (84895 N). E. L. Bruce. Ills. 2200 w. Can Min Inst, Bul—March, 1918. History of the district, difficulties of transportation, geology, deposits, etc.

Mine Supports

The Use of Concrete for Mine Supports (85261 A). George Knox. Ills. 3500 w. Colly Gdn—March 8, 1918. A memorandum prepared for the Board of the South Wales and Monmouthshire School of Mines.

Pillars

Drawing Pillars in Metal Mines (85221). W. R. Crane. Ills. 2000 w. Min & Sci Pr—March 23, 1918. Discusses only successful methods

Pit Props

The Strength of Pit Props (84833 A). F. L. Booth. 1500 w. Colly Gdn—Feb. 15, 1918 Read before N. of Eng. Inst. of Min & Mech. Engrs. Tabulated results of tests of crushing strengths of various sizes.

Quarries

French Quarries Inspected by U. S. Engineers (84619). Robert K Tomlin, Jr. Ills. 900 w. Eng News-Rec—Feb. 28, 1918. Hand labor the prevailing method of operation.

Shafts

Fireproofing Mine Shafts of the Anaconda Copper Mining Co (84964 D) F. M. Norris 1000 w. A I M E, Bul—March, 1918 Account of concrete applied with cement gun

Stripping and Re-lining a Shaft at Cowdenbeath, Fife (84834 A). Henry Rowan. 1500 w. Colly Gdn—Feb. 15, 1918. From paper before Min. Inst. of Scotland. Details of the work.

Shaft Signals

A "Responsive" Shaft Signal Device (85181 N). B. Angwin. Ills. 800 w. Instn Min & Met, Bul 161—Feb. 28, 1918. Illustrated description.

Steam Shovel

Steam-Shovel Mining on the Mesabi Range (84711). L. D. Davenport. Ills. 3000 w. Eng & Min Jl—March 2, 1918. Serial, 1st part. Present practice of the larger companies in open-pit mining.

Winding Engines

Overwinding and Controlling Devices for Winding Engines (84992 N). H. Newberry, with discussion. 8 pp. Instn E E, Trans—Nov., 1917. Brief description of scheme installed.

MINES AND DISTRICTS

British Empire

The Development of the Mineral Resources of the British Empire (84820 A). William Frecheville, with discussion. Maps. 10 pp. Roy Soc Arts, Jl—Feb. 22, 1918. Suggestions for development.

Canada

Canada—The Treasury of Her Mines (84746). Ills. 3000 w. Can Fndman—Feb., 1918. Serial, 1st part. Review of the mineral resources.

Preliminary Report on the Mineral Production of Canada During the Calendar Year 1917 (84874). John McLeish. 18 pp. Can Dept Mines, No. 478—Feb. 26, 1918.

The Production of Copper, Gold, Lead, Nickel, Silver, Zinc, and Other Metals in Canada During the Calendar Year 1916 (85268 N). 75 pp. Can Dept Mines—No. 471. Advance chapter of the annual report.

South Africa

The Industrial Resources of the Union of South Africa (84819 A). C. du Plessis Chiappini, with discussion. 16 pp. Roy Soc Arts, Jl—Feb. 15, 1918. Review of the industries and the problems of the present and future.

MINOR MINERALS

Calcification

The Replacement of Wood by Calcite (85056 B). C. W. Greenland. Ills. 800 w. Econ Geol—March, 1918. Describes material collected near Russell, Kansas.

Chromite

Chrome-Ore Specifications and Producers of Chromite in California (84713). 2200 w. Eng & Min Jl—March 2, 1918. List of producers and description of the largest Pacific Coast deposit.

Fertilizers

The Mineral Industries of the United States (84876). Part II. Fertilizers: An Interpretation of the Situation in the United States. Joseph E. Pogue. Ills. 20 pp. U S Natl Museum Bul 102, Part 2.

Manganese

Estimation of Manganese in Aluminum Alloys and Dust (84712). J. E. Clennell. 4500 w. Eng & Min Jl—March 2, 1918. Describes two methods which do not require its separation from all other constituents.

Greater Use of Domestic Manganese Supply (84918 A). F. Lynwood Garrison. 2500 w. Iron Age—March 14, 1918. Manganese ore output and needs.

Minerals

The Situation in Regard to Manganese, Sulphur, Pyrite, and Some Other War Minerals (85188 B). J. E. Johnson, Jr., with discussion. 25 pp. Engrs' Soc W Penn, Pro—Jan., 1918. Causes that have produced the situation, and suggestions.

Molybdenum

Molybdenum Industry in Norway (85031). Map. 3500 w. Eng & Min Jl—March 16, 1918. Excerpts from a paper by Ernest R. Woakes in Bull. 160 I. M. M. Facts regarding the present state of the industry.

Potash

A Study of the De Roode Method for the Determination of Potash in Fertilizer Materials (84766 B). T. E. Keitt and H. E. Shiver. 2500 w. Jl Ind & Eng Chem—March, 1918. Shows that the De Roode method overcomes difficulties encountered in other methods. Explains advantages.

Potash (84959 D). 15 pp. A I M E, Bul—March, 1918. Discussion at Jan. meeting of N. Y. Section.

Sulphur

The Mineral Industries of the United States (84877). Sulphur: An Example of Industrial Independence. Joseph E. Pogue. Ills. 8 pp. U S Natl Museum—Bul. 102, Part 3.

Tungsten

A Tungsten Deposit Near Fairbanks, Alaska (85055 B). Alan M. Bateman. 1500 w. Econ Geol—March, 1918. Brief description of this tungsten occurrence.

OIL AND GAS

Acetylene

Dissolved Acetylene and Its Storage (84679 A). 1800 w. Engr—Feb. 8, 1918. Recommendations of committee appointed to consider, and suggest amendments to regulations.

Gasoline

Recovery of Gasoline from Casing Head and Natural Gas (84911 A). Paul Diserens. Ills. 4500 w. E Cb St L, Jl—Jan.-Feb., 1918. Discusses recovery from casing-head gas.

Testing Natural Gas for Gasoline (84764 B). G. G. Oberfell. Ills. 2000 w. Jl Ind & Eng Chem—March, 1918. Report of tests with comments.

Naphthalene

The Trouble of Naphthalene (85207). 2000 w. Times Engng Supp—Feb. 22, 1918. Removal of deposits, methods of treatment, "Pleno" gas, etc., etc.

Oil

Home-Produced Oil (85209). 2700 w. Times Engng Supp—Feb. 22, 1918. Distillation of cannel coal discussed by British Inst'n Petroleum Technologists.

A New British Oil Industry (84836 A). E. H. Cunningham Craig. 2500 w. Colly Gdn—Feb. 22, 1918. From paper before Instn of Petroleum Tech. On prospects of founding a new industry for increasing supplies of fuel oil, including petrol.

A New British Oil Industry (85132 A). 1000 w. Nature—Feb. 28, 1918. Progress in the discovery and utilization of coals and shales that will yield oil.

Oil Fuel

Burning Oil Fuel (84638). A. Gordon. 2200 w. Natl Engr—March, 1918. Comparative performance of oil and coal as fuel.

Oil Handling

Gaging and Storage of Oil in the Mid-Continent Field (84966 D). O. U. Bradley. Ills. 10 pp. A I M E, Bul—March, 1918. Features of the handling practice.

Oil Seeds

Indian Trade in Oil Seeds (85038 N). 75 pp. Imp Inst, Bul—July-Sept., 1917. Statement showing the great value of the Indian oil seed trade, and the desirability of securing a far larger proportion of the output.

Three New Oil Seeds from West Africa (85036 N). 1500 w. Imp Inst, Bul—July-Sept., 1917. Information concerning N'gore nuts, N'kamba nuts, and Strephonema kernels.

Oil Wells

Oil Well Drilling (85047 A). W. C. Bochert. Ills. 13 pp. Pahasapa Qr—Feb., 1918. Progress of drilling methods.

Petroleum

Petroleum Production in Texas Over 5,000,000 Barrels Increase for 1917 (84680). 1200 w. Mfrs' Rec—Feb. 28, 1918. Statistics of production and information relating to the oil industry.

The History of Petroleum Production (85048 A). W. A. Waldschmidt. Table. 3000 w. Pahasapa Qr—Feb., 1918.

The Refining of Petroleum (85046 A). M. L. Hartmann. Ills. 11 pp. Pahasapa Qr—Feb., 1918. Processes and products developed.

Sperm Oils

Some Data on Sperm Oils Used for Burning in Miners' Safety Lamps (85223). A. G. Blakeley and E. A. Reilly. 1000 w. Cl Age—March 23, 1918. Results of investigations, with explanatory notes.

ORE DRESSING

Copper

The Relation of Sulphur to the Overpoling of Copper (84963 D). Stanislaus Skowronski. Ills. 1200 w. A I M E, Bul—March, 1918. Experiments show that sulphur is the direct agent.

Copper Cathodes

Oxygen and Sulphur in the Melting of Copper Cathodes (84962 D). Stanislaus Skowronski. 1000 w. A I M E, Bul—March, 1918. Gives results of samples taken at regular intervals during the melting and refining.

Copper Ore

Nitric Acid and Copper Ore (84956 A). George C. Westby. Ills. 4000 w. Met & Chem Eng—March 15, 1918. Story of an attempt to utilize nitric acid in ore treatment.

Flotation

Minerals Separation v. Butte & Superior (85060). Also editorial. 5000 w. Min & Sci Pr—March 16, 1918. Part of brief for defendant. It is contended, in limiting the flotation of plaintiff to the "critical" proportions of oil that defendant had not infringed.

Minerals Separation v. Butte & Superior (85222). Also editorial. 7000 w. Min & Sci Pr—March 23, 1918. Part of brief for plaintiff-appellee.

The Groch Flotation Machine (84,896 N). F. O. Groch and W. E. Simpson. Ills. 1200 w. Can Min Inst, Bul—March, 1918. Summarizes general principles underlying the flotation process, and describes this machine of the froth-forming type.

Utah Leasing Company's Flotation Plant at Newhouse, Utah (85224). H. H. Adams. Ills & flow sheets. 1800 w. Eng & Min Jl—March 23, 1918. Reworking tailings in a 700-ton flotation plant.

Leaching

The 2000-Ton Leaching Plant at Anaconda (85058). Frederick Laist and H. J. Maguire. Ills. 2500 w. Min & Sci Pr—March 16, 1918. Tailings amounting to 20,000,000 tons is to be treated.

Precipitation

The Application of Charcoal to the Precipitation of Gold from its Solution in Cyanide (85008 N). H. R. Edmands. Ills. 25 pp. Instn Min & Met, Bul 161—Feb. 28, 1918. Investigations in the field of charcoal precipitation.

Roasting

The Humboldt Roasting Plant (84,810). A. A. Watson. Ills. 800 w. Min & Sci Pr—March 9, 1918. Erecting, in Arizona, four Wedge roasting furnaces; capacity 150 tons per furnace daily.

Smelting

Blast-furnace Smelting at Stibnite with Considerations on the Metallurgy of Antimony (85099 N). W. R. Schoeller. 31 pp. Instn Min & Met, Bul 161—Feb. 28, 1918. Attempts made to smelt unroasted stibnite ores in water-jacketted blast furnaces. Review of metallurgical treatment of antimony ores.

Smelting and Ore-Sales Investigations in Colorado (85225). 6000 w. Eng & Min Jl—March 23, 1918. Methods reviewed by O. R. Whitaker. Deals with factors affecting operation of lead-smelting rooms.

PRECIOUS METALLURGY

Bendigo

Factors Influencing Gold Deposition at Bendigo (85231 N). 2200 w. Onsd Gov Min Jl—Feb., 1918. Summary from Bul. of the Advisory Council of Science and Industry.

Replacement in the Bendigo Quartz Veins and Its Relation to Gold Deposition (85054 B). F. L. Stillwell. Ills. 12 pp. Econ Geol—March, 1918. Investigation into the causes affecting the distribution of gold in quartz. General conclusions.

Decantation

Continuous Decantation at Yuanmi Gold Mines Limited (84697 N). V. T. Edquist. Ills. 1500 w. Chain Mines W Aust Mthly Jl—Nov., 1917. Process and details of conversion of plant.

India

Air Blasts in the Kolar Gold Field, India (84967 D). E. S. Moore. 3000 w. A I M E, Bul—March, 1918. Geological formations, description of air blasts, their origin, conclusions, etc.

Platinum

How Draper Brought Out the Platinum (85032). 2500 w. Eng & Min Jl—March 16, 1918. Account by F. W. Draper in Bul. 116, Jan. 31, 1918, M. M. S. A.

Queensland

The Recent Gold Rush at Kin Kin, near Gympie (85226 N). Lionel C. Ball. Map & Ills. 1500 w. Onsd Gov Min Jl—Feb., 1918. Information concerning the prospects.

Silver

An American Policy Regarding Silver (85220). Emmet D. Boyle and Whitman Symmes. 1200 w. Min & Sci Pr—March 23, 1918. Sources of silver; contrast between international economic policy of Great Britain and America.

Witwatersrand

Witwatersrand Gold Fields (85249 N). 8 pp. S Af Inst Elec Engrs, Trans—Dec., 1917. Recommendations concerning A. C. Sub-stations operating at working pressures exceeding 250 volts.

MISCELLANY

Mineral Industry

The Mineral Industry After the War (84893 N). Alfred W. G. Wilson. Excerpts from a paper read at Montreal. 2500 w. Can Min Inst, Bul—March, 1918. Reviews Canadian position and problems.

Mining Debris

Hydraulic-Mining Debris in the Sierra Nevada (85059). G. K. Gilbert. Ills. 2800 w. Min & Sci Pr—March 16, 1918. Discussion on the quantity and ultimate deposition.

Mining Industry

The Mining Industry in Relation to the Military Service Act (84894 N). Norman R. Fisher. 3000 w. Can Min Inst. Bul—March, 1918. Editorial letter stating the case of the silver mining industry of Northern Ontario.

The Government and the Mining Industry (84892 N). 3000 w. Can Min Inst, Bul—March, 1918. Text of a memorandum recently submitted to the Prime Minister of Canada.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION

Batteries

Batteries and Switchboards (85085 C). 1000 w. Ry Sig Assn, Jl—March, 1918. Directions for installation of lead type stationary storage battery.

Coal Distribution

The New Zone System of Coal Distribution (85154). 4000 w. Ry Age—March 22, 1918. Plan for avoiding cross hauling of coal.

Discipline

Discipline in the Signal Department (84654). Robert B. Elsworth. 1800 w. Ry Age—March 1, 1918. Considers the fundamental requirements of discipline.

France

La Nouvelle Organisation du Contrôle des Chemins de Fer (85126 B). J. Trévières. 3200 w. Le Génie Civil—Feb. 9, 1918. New regulations for French railways. Decree of Jan. 8, 1918.

German Railways

Germany's Railway Situation Is Most Serious (84650). 3500 w. Ry Age—March 1, 1918. Prussia's railroads had a deficit of $50,000,000 in 1917.

Government Control

McAdoo's Instructions to Regional Directors (84645). 2200 w. Ry Age—March 1, 1918. Outline of their functions and of policy of Director General for operation under government control.

Interlocking

Power Interlocking (85086 C). Ills. 700 w. Ry Sig Assn, Jl—March, 1918. Typical circuits, and requisites for first range voltage electric interlocking.

Italy

Il Problema Ferroviario Nel Dopo-Guerra (85106 B). G. Prato. 4200 w. Industria—Jan. 31, 1918. The status of the Italian State railways after the war.

Operation

Activities of the Director-General (84861 A). 3500 w. Ry Mech Engr—March, 1918. New appointments; standard car and locomotive committees; labor.

Report of Committee XXI—On Economics of Railway Operation (85016 C). 44 pp. Am Ry Eng Assn, Bul—Jan., 1918. Brief report with extensive bibliography.

Pennsylvania R. R.

A Year of New Records, Emergencies and Changing Conditions (84809). Ills. 2500 w. Ry Rev—March 9, 1918. From report for 1917.

Signaling

Alternating Current Automatic Block Signaling (85088 C). 10 pp. Ry Sig Assn, Jl—March, 1918. Specifications for a.c. motor semaphore signals.

A. C. Automatic Signal Work on the Monongahela (84866). George H. Burnette. Ills. 1200 w. Ry Sig Engr—March, 1918. Describes installation, discussing problems encountered.

Discussion on "Electrical Signalling and Control on Railways" (85247 N). 6 pp. Instn E E, Jl—March, 1918. Paper by C. M. Jacobs. Continued discussion.

Methods of Pole Line Construction (84867). J. C. Martine. Ills. 1700 w. Ry Sig Engr—March, 1918. Common faults and means of overcoming them.

Signalling and Interlocking of Keadby Railway and Bridge (84840 A). James Benjamin Ball. Ills. 3500 w. Engng—Feb. 15, 1918. Serial, 1st part. Read before Inst. of Civ. Engrs.

Signaling Practice (85087 C). Ills. 30 pp. Ry Sig Assn, Jl—March, 1918. Report of Committee X.

Signals

Frost and Moisture in Signal Mechanism and Motor Cases (85089 C). 8 pp. Ry Sig Assn, Jl—March, 1918. Report of Albany regional committee.

Inspection of Signal Apparatus (85090 C). A. B. du Bray. 10 pp. Ry Sig Assn, Jl—March, 1918. Report of Kansas City regional committee.

Snow

Recent Operating Difficulties on Pennsylvania R. R. (84694). Ills. 2500 w. Ry Rev—March 2, 1918. From report of Elisha Lee to the president of the Pennsylvania R. R. Account of difficulties due to unusually severe winter weather.

The Pennsylvania's Fight with Jack Frost and the Snow Banks (84646). Ills. 2000 w. Ry Age—March 1, 1918. Abstract of report of Elisha Lee of experiences on lines east of Pittsburgh.

MOTIVE POWER AND EQUIPMENT

Axles

La Fabrication Des Essieux De Wagons Et De Locomotives (85108 C + D). L. Geuze. Ills. 3500 w. Revue De Métallurgie—Nov.-Dec., 1917. A study of the methods of manufacture of car and locomotive axles.

Cars

Michigan Central Refrigerator Car (84863 A). Ills. 1000 w. Ry Mech Engr—March, 1918. Particular attention given to insulation.

Refrigerator Cars for the Michigan Central (84975). Ills. 1000 w. Ry Age—March 15, 1918. Design represents most modern practice.

Dynamic Augment

Dynamic Augment—Need and Means of Reducing It (84887 A). E. W. Strong, with discussion. Ills. 45 pp. N Y Rd Cb, Pro—Feb. 15, 1918. Meaning of the term and the importance of the problem in the design of modern locomotives.

Electricity

Report of Committee XVIII—On Electricity (85024 C). Ills. 37 pp. Am Ry Eng Assn, Bul—Feb., 1918. Data on overhead clearance, electrolysis and insulation, etc.

Electric Locomotives

Four Improved Types of Electric Locomotives (85153). Maps & Ills 3000 w. Ry Age—March 22, 1918. Recent developments to meet demands of traffic and profile.

New Haven Orders Five 180-Ton Electric Locomotives (85004). Ills. 700 w. Eng News-Rec—March 21, 1918. Needed to haul trains over New York connecting railroad, where grades are too heavy for present power.

Electric Vehicles

Midland Railway Electrics (84644 A). Ills. 1800 w. Elec Rev—Feb. 8, 1918. Deals with vehicles put into service by this railway. Based on article in the *Commercial Motor*.

Electrification

Opening Address by President E. W. Rice, Jr., at A. I. E. E. Midwinter Convention, February 15, 1918 (84768 D). 2500 w. A I E E, Pro—March, 1918. On railway electrification as a means of saving fuel and relieving freight congestion.

Einige technische Notizen über die elektrische Langenthal-Melchnau Bahn (85101 B). F. Marti-Ziegler. Ills. 3100 w. Bul Schweiz Elektrotechnischer Verein—Jan., 1918. Electrical details of mountain railway between Langenthal and Melchnau. Equipment, signaling, etc.

Locomotive Boilers

Increase Life and Service of Locomotive Boilers (84653). George Austin. Ills. 2500 w. Ry Age—March 1, 1918. Treating feed water to prevent scale and corrosion.

Locomotives

Consolidation Type Locomotives for French Railways (84787). Ills. 700 w. Ry Age—March 8, 1918. Recently completed French locomotives, built in America.

Intensive Locomotive Development (84860 A). O. S. Beyer, Jr. Ills. 2000 w. Ry Mech Engr—March, 1918. Serial, 1st part. Possibilities of greater economy of operation.

Locomotives for the French State Railways (84726 A). Ills. 1200 w. Ry & Loc Eng—March, 1918. Engines recently completed by the American Locomotive Co.

Motive Power

Winter Temperatures and Locomotive Capacity (84968). W. L. Bean. 1400 w. Ry Age—March 15, 1918. Study of the relation between decreasing temperature and increasing motive power requirements.

Steel Cars

Development of the Steel Car (84,651). Henry P. Hoffstot, before Traffic Club of Pittsburgh. 1500 w. Ry Age—March 1, 1918. Reviews the history of the development.

Tires

La Fabrication Des Bandages De Roues De Wagons Et De Locomotives (85109 C + D). L. Geuze. Ills. 5700 w. Revue De Métallurgie—Nov.-Dec. 1917. Methods of manufacture of tires for locomotives and cars.

Wheel Centers

La Fabrication Des Centres De Roues De Wagons (85110 C + D). L. Geuze. Ills. 4300 w. Revue De Métallurgie —Nov.-Dec., 1917. Manufacture of car wheel centers by the five-roll method.

PERMANENT WAY AND BUILDINGS

Ballast

Report of Committee II—On Ballast (85027 C). 44 pp. Am Ry Eng Assn, Bul—Feb., 1918. Depth of ballast of various kinds, etc.

Crossings

Report of Committee IX—On Signs, Fences, and Crossings (85026 C). Ills. 64 pp. Am Ry Eng Assn, Bul—Feb., 1918. Principles, legal requirements, over and undergrade crossings, etc.

Freight House

New Freight House of the Pennsylvania Lines in Chicago (84977). Ills. 1500 w. Ry Rev—March 16, 1918. Details of one of the largest and best equipped stations in the United States.

Freight Station

Freight Station and Warehouse Has 23 Acres of Floor (84616). Ills. 1800 w. Eng News-Rec—Feb. 28, 1918. Six-story structure of standardized design houses L. C. L. clearing house.

Light Railways

Large Mileage of Light Railways Will Serve American Troops at the Front (84923). Robert K. Tomlin, Jr. Ills. 2200 w. Eng News-Rec—March 14, 1918. Organization for big construction programme.

Masonry

Report of Committee VIII—On Masonry (85028 C). Ills. 44 pp. Am Ry Eng Assn, Bul—Feb., 1918. Report and appendices.

Rail Heads

Inhibited or Delayed Transformations in Rail Heads (85022 C). Dr. P. H. Dudley. 2000 w. Am Ry Eng Assn, Bul—Jan., 1918. Associated with two or more conditions of the steel, indicated by cores or zones. Appendix G.

Rails

Intensity of Pressure on Rails (85,023 C). Appendix H. Ills. 48 pp. Am Ry Eng Assn, Bul—Jan., 1918. Report on rational relation between intensity of pressure due to wheel loads and resistance of rail steel to crushing.

Report of Committee IV—On Rail (85021 C). 17 pp. Am Ry Eng Assn, Bul—Jan., 1918. Report and appendices.

Roadway

Report of Committee I—On Roadway (85020 C). 5 pp. Am Ry Eng Assn, Bul—Jan., 1918. Best method of draining, etc.

Shops

Car Building Plants and Railroad Repair Shops (84789). 1200 w. Ry Age —March 8, 1918. Interesting figures from Census Report.

Structures

Report of Committee XV—On Iron and Steel Structures (85030 C). Ills. 84 pp. Am Ry Eng Assn, Bul—Feb., 1918. Methods of protection against corrosion: types, floors, water-proofing tests, specifications, etc.

Terminals

Elevated Terminal Connection at Kansas City (84785). Ills. 3000 w. Ry Age—March 8, 1918. A long two-track steel viaduct and a heavy double-deck bridge of unique design.

A Union Package Freight Terminal at Jersey City (84640). Map. 2200 w. Ry Age—March 1, 1918. Plan for handling of L. C. L. freight at New York to reduce congestion and expedite movement.

New York Central Builds $4,000,000 High-Level Freight Terminal at Cleveland (84920). W. E. Phelps. Ills. 5500 w. Eng News-Rec—March 14, 1918. Plant almost completed has separate inbound and outbound houses.

Report Committee XIV—On Yards and Terminals (85017 C). 34 pp. Am Ry Eng Assn, Bul—Jan., 1918. Nineteenth annual report.

Ties

Report of Committee III—On Ties (85019 C). Ills. 35 pp. Am Ry Eng Assn, Bul—Jan., 1918. Methods of controlling tie renewals, etc.

Tracks

Action of Railway Track Studied by Tests of Depression and Rail Stress (84926). Ills. 3500 w. Eng News-Rec —March 14, 1918. Rigid construction and thorough tamping reduce rail stress.

New Machines Facilitate Track Maintenance Work (84922). Ills. 1200 w. Eng News-Rec—March 14, 1918. Apparatus to increase efficiency and economy on track upkeep.

Progress Report on Stresses in Track (85033 C). Ills. 184 pp. Am Ry Eng Assn, Bul—March, 1918. Tests and results.

Resilient Chairs and Ferro-Concrete Sleepers (84841 A). Ills. 3000 w. Engng—Feb. 22, 1918. Details of design of an effective concrete sleeper, as shown in sleeper adopted on East Indian Railway.

Track Scales

Baltimore & Ohio Weighing Bureau (84969). L. D. Davis. 1300 w. Ry Age —March 15, 1918. Design and installation of track scales, their proper care and maintenance.

Trestles

Reports of Committee VII — On Wooden Bridges and Trestles (85025 C). 26 pp. Am Ry Eng Assn, Bul—Feb., 1918. Report and appendices.

Turntable

60-Ft. Locomotive Turntable at Newhaven (84676 A). Ills. & Plate. 300 w. Engr—Feb. 1, 1918. Novel features in design.

Yards

Pennsylvania Builds Large Gravity Yard at Indianapolis (84925). Ills. 1500 w. Eng News-Rec—March 14, 1918. Development at Hawthorne designed for immediate capacity of 3500 cars and ultimate capacity of 10,000 cars.

ROADS AND PROJECTS

Australia

Un Nouveau Chemin De Fer Transcontinental (85141 B). C. Maillard. Ills. 2200 w. Revue Générale des Sciences—Feb. 15, 1918. The projected transcontinental route from Melbourne to Perth, in West Australia.

Foreign Railways

New Railways in Foreign Lands (85219). 2500 w. Ry Rev—March 23, 1918. Résumé of railway enterprises now under way in various parts of the world.

France

Comment Exploiter Au Mieux Les Voies Ferrées? (85144 B) J. Carlier. 2100 w. Le Génie Civil—Mar. 2, 1918. Suggestions for much needed development of French railways.

Korea

The Japanese Operated Railroads of Korea (84788). Map and Ills. 4000 w. Ry Age—March 8, 1918. Over 1000 miles of railway constructed in Korea in less than twenty years.

Sind-Pishin Ry.

"A Free Route to Persia and Afghanistan" (84976). Map. 5000 w. Ry Age—March 15, 1918. Abstract from E. A. Pratt's "Rise of Rail Power in War and Conquest." How England built her Sind-Pishin Ry. to protect the Indian frontier.

MISCELLANY

Contract Forms

Report of Committee XX—On Uniform General Contract Forms (85018 C). 17 pp. Am Ry Eng Assn, Bul—Jan., 1918.

Organization

Report of Committee XII On Rules and Organization (85029 C). 14 pp. Am Ry Eng Assn, Bul—Feb., 1918. Science of organization; bibliography; etc.

Railway Reports

Year's Work of Railway Engineering Committees Reviewed (85093). 3000 w. Eng News-Rec—March 21, 1918. Summary of reports submitted at Chicago meeting of A. R. E. A.

Railway Supplies

American Railway Supplies in Australia (85150). Map and Ills. 5500 w. Ry Age—March 22, 1918. From report of Frank Rhea. Encouraging outlook.

Selling to Railroads Under Government Control (84970). 2200 w. Ry Age—March 16, 1918. Orders placed will be large and changes in standards and methods less than have been feared.

INDUSTRIAL MANAGEMENT

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Time Studies for Rate Setting on Machine Tools

By Dwight V. Merrick

Readers of INDUSTRIAL MANAGEMENT *are to be congratulated on the series of articles of which this is the first installment—a series dealing with the fundamentals of machine-shop time studies for rate setting. In this article is a statement of just what is meant by time study, an outline of the work that must be done before a study can be taken, a chart for variation allowances and an outline of the elements in studying one machine tool—a boring mill.*

Mr. Dwight V. Merrick *served a three years' machinist apprenticeship in the shop of the Southwark Foundry & Machine Company, going from there as a journeyman machinist to William Sellers & Company, where he remained for one year. He then spent two years in the engineering course at Drexel Institute. At the completion of this studying he went back to the Southwark Foundry & Machine Company and served as a draftsman for three years, leaving in* 1898 *to go with Mr. Frederick W. Taylor at the Bethlehem Steel Company. In* 1901 *he left Bethlehem to go to the Link Belt Engineering Company, where he remained until* 1911 *devoting himself to time study work. The following two years,* 1911-1913, *were spent in time study in the shops of the Watertown Arsenal. From* 1913 *to date* Mr. Merrick *has devoted himself to a consulting practice in time study, giving most of his efforts to the H. H. Franklin Manufacturing Company, Syracuse, N. Y., and the Winchester Repeating Arms Company.*

IN June, 1895, the late Dr. Frederick W. Taylor read a paper before the Detroit meeting of the American Society of Mechanical Engineers entitled "A Piece-Rate System." At that time he presented to engineers his idea of elementary, or unit, time studies and the use he had made of them in task and rate setting at the Midvale Steel Company, Philadelphia. The significance of his principles and methods were not then appreciated. In 1903, he presented before the same society a paper dealing with matters of industrial management under the title "Shop Management," and then it was that some engineers and manufacturers began to understand the trend and importance of time-study work.

Although Dr. Taylor personally never had the opportunity to apply his ideas and practice except in manufacturing a comparatively simple product his faith in elementary time studies as the correct means for obtaning information for just task and rate setting was absolute. He predicted the preparation and widespread use of books containing classified and conveniently arranged unit times, so that a properly experienced man could predetermine a just time allowance for any job that might be resolved into its elementary operations.

Some 19 years ago the writer became associated with Dr. Taylor, and for the last 15 years has specialized on the taking of time studies and the setting of tasks and rates. The ordinary studies on machine tools were all taken in shops where the information derived was to be made of immediate use, but the improved time studies which form the basis of this series of articles were taken on a line of boring mills manufactured by the Gisholt Machine Company, Madison, Wisconsin. They were taken in the shops of that company under conditions of the most cordial coöperation. It is hoped that they form but a very small beginning of the work that will eventually be done for all standard machine tools. The advantages will be two-fold: The development of facts and data to influence and improve machine-tool design, particularly along the side of operation; and the furnishing of basic information for the setting of base times and rates on these same machines.

ELEMENTARY OR UNIT TIME

By elementary or unit time is meant the minimum time required by a first class, but not extraordinary, worker to perform an elementary or unit operation.

When a task is set the total time allowance is the sum of all the unit times for both the hand and the machine component operations, plus a certain allowance to cover possible variations from a normal speed of the machine applied in the form of a percentage on the machine time, plus an allowance on the elementary selected handling times applied in the form of a percentage of these handling times. In some instances allowances must also be made for standard interferences and delays; these are local or shop standards and are more often necessary on heavy work than elsewhere. On certain types of light, confining work allowances must also be made for necessary rest periods.

OBJECT OF TIME STUDY

Time stuly has for its objects: 1. The determination of possible improvements in the equipment and surrounding conditions for producing a given piece of work. 2. The determination of possible improvements in the actual doing of the work by the operator. 3. The determination of a unit time in which a given piece of work should be finished, or the setting of a task for that piece.

The taking of time studies may be divided into six sub-divisions: (a) Study of the work and conditions that influence its performance; (b) Analysis of the work into its elements; (c) observing and recording the elapsed time for the performance of each of the elements; (d) study and analysis of the records obtained in (c); (e) determining a just time for the performance of each of the elements; (f) preparing from the time-study records of an instruction card, including the determining of an allowance for fatigue and unavoidable delays.

Only items (b) to (d), inclusive, are comprised in time-study proper. However, the term "time study" has been broadened to comprehend the utilization of the information derived from time studies and the setting of tasks and fixing unit times. In this series of articles this broader meaning of the term will be followed.

A FEW PRACTICAL CONSIDERATIONS

It may be helpful to give in the form of short paragraphs a few practical points in regard to taking and using time studies.

1. In the main, time studies can be divided into two general classes: First, that class where the product to be rated is produced in great quantities and does not vary at frequent intervals. In such cases it is wiser to take a study of each operation as a job complete in itself and from this study set the rate. Second, that class where the product does vary frequently. In these cases it is often impractical to study each operation of every job. Much machine-shop work is of this character. So a sequence of component studies must be resorted to if rates are to be set for a considerable number of jobs without entailing a prohibitive cost in taking time studies and setting the rates.

2. The data derived from taking time studies must be made available in such a form that complete instruction cards can be written and rates set without the necessity of taking time studies on each element of each new job.

3. As a feature of good practice time studies are usually made on a second or third piece of a job, not on the first one.

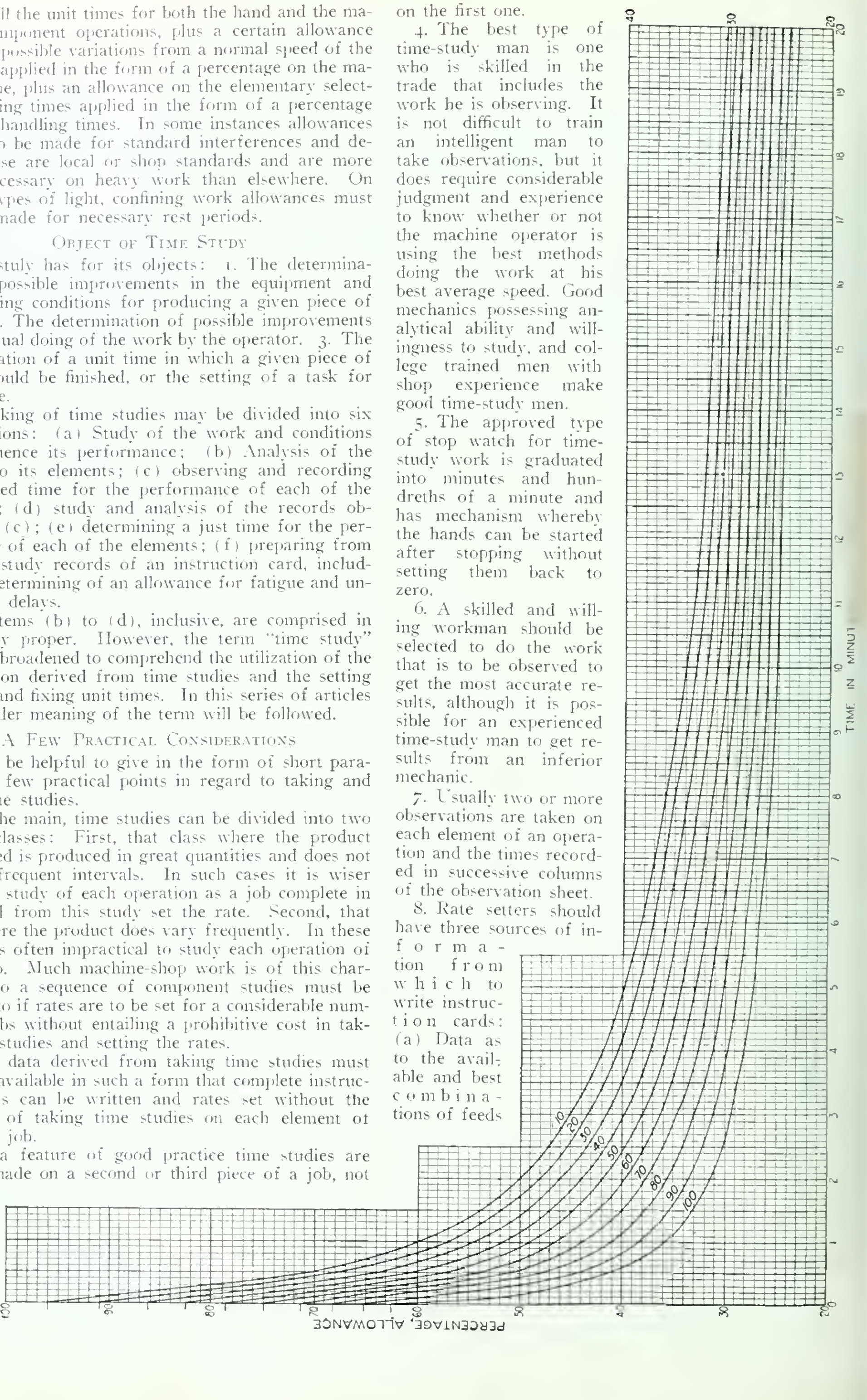
4. The best type of time-study man is one who is skilled in the trade that includes the work he is observing. It is not difficult to train an intelligent man to take observations, but it does require considerable judgment and experience to know whether or not the machine operator is using the best methods doing the work at his best average speed. Good mechanics possessing analytical ability and willingness to study, and college trained men with shop experience make good time-study men.

5. The approved type of stop watch for time-study work is graduated into minutes and hundreths of a minute and has mechanism whereby the hands can be started after stopping without setting them back to zero.

6. A skilled and willing workman should be selected to do the work that is to be observed to get the most accurate results, although it is possible for an experienced time-study man to get results from an inferior mechanic.

7. Usually two or more observations are taken on each element of an operation and the times recorded in successive columns of the observation sheet.

8. Rate setters should have three sources of information from which to write instruction cards: (a) Data as to the available and best combinations of feeds



and speeds from which the actual time of cutting may be computed; (b) tabulated time-study information covering various kinds of handling time; (c) time-studies for the elements of the job for which information is not available under (a) and (b).

9. The *desired task time* is the one that can be equalled by workmen following instructions and working at a reasonable pace, that is, one that can be kept up from day to day without undue exertion.

10. Instruction cards have a most beneficial effect on the management. After a rate has been set no allowance can be made on the job except for causes over which the workman has no control; extra allowance must be made only for defective or hard material, lack of tools, machine out of repair, or similar items for which the management is responsible. So the cutting down of the workman's production brings home to the executives their own failures.

VARIATION ALLOWANCES

The limits of space prevent a presentation here of the methods used to determine the "variation allowance" curves given in Figure 1; but the use of this plotting will be explained. The term "variation allowance" has been adopted instead of fatigue allowance, as better describing the additions that must be made to the actual sum of the unit times to take care of the factors that slow down work. To be sure, fatigue is one of the major factors, particularly where the cycle of operations is short, requiring frequent and rapid movements by the operator; also where the handling time or period of actual physical exertion is a large part of the whole. As the length of the cycle increases, and the percentage of handling time is lessened, the influence of fatigue is relatively diminished. In such cases unavoidable delays may have a greater influence than fatigue itself.

These features are clearly shown by the curves of Figure 1, in which the allowances for the short cycles call for higher percentages than for the long cycles, which offer rest periods within the cycle themselves.

The variation allowance curves of Figure 1, on the opposite page, represent the result of thousands of actual studies in many different machine shops extending over a number of years. The mathematical formula derived by Mr. Carl G. Barth is:

$$\frac{P}{} = \frac{20}{} + \frac{49.5 - 0.325C}{\sqrt{(0.376 - \quad 0.00002166)^2 + T}}$$

in which *P* is the percentage allowance, *C* the percentage of handling time and *T* the minimum selected time.

Ten curves cover conditions from 10 per cent. handling time and 90 per cent. machine time, to 100 per cent. handling time and no machine time. They are applicable to average machine-shop practice in shops well ventilated, properly heated and well lighted. They may not apply to other industries where ventilation and temperature conditions tend to enervate the workers. The allowances selected from these curves are applicable to time studies taken and analysis made according to the methods of the writer.

The following tabulation gives the time division for each curve and its particular formula:

CURVE 10	10% handling time 90% machine time	$P = 20 + \frac{46.25}{\sqrt{0.37384 + T}}$
CURVE 20	20% handling time 80% machine time	$P = 20 + \frac{43.00}{\sqrt{0.36736 + T}}$
CURVE 30	30% handling time 70% machine time	$P = 20 + \frac{39.75}{\sqrt{0.35656 + T}}$
CURVE 40	40% handling time 60% machine time	$P = 20 + \frac{36.50}{\sqrt{0.34144 + T}}$
CURVE 50	50% handling time 50% machine time	$P = 20 + \frac{33.25}{\sqrt{0.322 + T}}$
CURVE 60	60% handling time 40% machine time	$P = 20 + \frac{30.00}{\sqrt{0.29824 + T}}$
CURVE 70	70% handling time 30% machine time	$P = 20 + \frac{26.75}{\sqrt{0.27016 + T}}$
CURVE 80	80% handling time 20% machine time	$P = 20 + \frac{23.50}{\sqrt{0.23776 + T}}$
CURVE 90	90% handling time 10% machine time	$P = 20 + \frac{20.25}{\sqrt{0.20104 + T}}$
CURVE 100	100% handling time No machine time	$P = 20 + \frac{17.00}{\sqrt{0.16 + T}}$

In making use of these curves, select the particular curve corresponding most nearly to the percentage of handling time in the cycle on which the allowance is to be made. The percentage is taken upon the total of the handling time—that is, if a job requires three minutes machine time and two minutes handling time the 40 per cent. curve would be used. On this curve the intersection of the two-minute ordinate gives the allowance to be added to the handling time when making up the instruction card for the job assumed. A flat allowance of 5 per cent. is added for machining time with power feed, and 20 per cent. is added for machining time with hand feed.

MACHINE TIME STUDIES

In taking up machine time-studies the terms that will recur frequently are defined as follows:

Element or elementary operation. The smallest subdivision of the job or work that is to be studied. Fundamental operations are made up by combining elements. Example: Take up wrench; tighten nut.

Fundamental operation. A sequence of elements comprising the performance of some definite portion of a job. A single fundamental operation may apply to several different classes of work or to several different sizes and types of machine. Example: Put tool in tool post; remove tool from tool post; move head along rail, etc.

Complete operation. A division of machine work that is complete in itself. It is made up of one or more fundamental operations.

Job or Work. The combination of complete operations necessary to the completion of the work in a single machine. Example: Boring a cylinder; planing a lathe bed, milling the teeth of a gear.

Right hand (of a machine). That portion of the machine that is at the right of the workman as he stands in front of and facing it.

Left hand (of a machine). That portion of the machine that is at the left hand of the workman as he stands in front of and facing it.

ANALYSIS OF THE WORK

The taking of a machine time study consists in analyzing the complete operations that are possible on a machine and determining by means of a stop watch the length of time required for the performance of each of these operations. In machine-shop practice work can be divided under the following heads:

1. Preparing the machine to receive the work (from normal condition).
2. Landing the work in the machine.
3. Squaring, levelling and making the work run true.
4. Clamping or otherwise securing the work in the machine.
5. Setting tools.
6. Manipulating the machine to start the cut. (Includes calipering and gaging).
7. Machining—that is, removing metal.
8. Manipulating the machine at the end of the cut.
9. Removing the tools.
10. Removing the clamps and securing devices.
11. Removing the work from the machine.
12. Restoring the machine to its normal condition.

In preparing instruction cards and predetermining rates for a job the foregoing sequence is also followed.

In time-study work a normal condition is assumed for each machine. This normal condition is that which will enable it to accommodate, without change, the greatest number of jobs that will come to it in the regular work of the shop. For instance, in the case of a boring mill the rail will be left at a certain elevation above the table, the heads at either end of the rail and the rams set at right angles to the rail. At the conclusion of each job, the machine should be restored to its normal condition. The purpose of this restoring to normal condition is to facilitate the setting of tasks on the machine by giving the man who writes the instruction cards a definite starting point in laying out the work. As will become apparent later, a large percentage of the time involved in most machine work is concerned with the preparation of the machine for the work. All instruction cards and task times will be inaccurate if the machine is in any other than the normal condition when the workman commences work upon it. In taking time studies also a normal position should be assumed for the workman—that is, the position in which he would ordinarily be found at the commencement of the operation in question. Thus, in machining work on a boring mill, the workman would naturally take his place at the end of the cross-rail, and this position would be his normal position for the beginning of the immediately following operation—that is, loosening and removing clamps.

CLASSIFICATION OF OPERATIONS

The various items of the classification of work outlined above may be more thoroughly defined as follows:

1. *Preparing the machine to receive the work.* This includes all adjustments of the machine necessary to fit in for the reception of work, such as the adjustment of chuck jaws, the removal or placing of faceplates or chucks, the adjustment of the footstock, etc., in the case of lathes; the raising of the rail, the movement of the heads, etc., in the case of planers and boring mills; and similar operations that can readily be called to mind on other machines.

2. *Landing the work in the machine.* This item includes the lifting and placing of the work in position ready for clamping or otherwise fastening in the machine by hand. Or, if the piece is too heavy to be moved by hand, the attaching of slings, and hoisting by means of block and chain hoist, pneumatic hoist or crane, the movement or traverse of the work to the machine, the landing of it in position in the machine and the removal of the slings.

3. *Squaring, levelling and making the work run true.* This item includes all operations necessary to make the surface that is to be machined conform approximately to the path of the cutting tool.

Squaring involves the operations necessary to locate the principal edge of the work parallel to the edge of the table or to the path of the cutting tool where one or the other has a reciprocating motion. This operation is necessary principally in connection with planers, shapers and slotters.

Levelling involves those operations necessary to bring the working surface parallel to the platen, or table, on which the work is supported. Work is levelled on the tables of planers, boring mills, drilling machines, shapers, etc. Although, using the term in its strict sense, work clamped to the faceplate of a lathe is not levelled, nevertheless the operations involved in locating the working surtace parallel to the faceplate are the same as when the work is clamped to a horizontal surface, and so such operations in lathe work are properly classified as levelling.

Making work run true involves those operations required to make work carried on centers, or supported on a rotating surface as a lathe faceplate or boring mill table, assume the same axis of rotation as that of the machine itself.

4. *Clamping or otherwise securing the work in the machine.* This item includes the tightening of chuck jaws on the work, placing clamps and blocks and tightening the bolts and nuts that hold them on the work, tightening vise jaws, and setting and making firm all attachments that hold the work in position for the cutting operations.

5. *Setting tools.* This item includes placing and tightening all cutting tools in the tool post, or tool block, and making them ready for work. It does not, however, include the manipulation of the machine to bring the tool in proper position with relation to the work to begin removing metal.

6. *Manipulating the machine to start the cut.* This item involves all machine movements, including those necessary to bring the cutting tool into its proper relation to the work, and the preliminary operations of the machine necessary to turn short lengths on cylindrical work, and so obtain the space necessary for calipering to ascertain whether or not the tool is in the correct position. It also comprises the starting of the actual machining operation by throwing in the feed mechanism at the beginning of the cut, and releasing it at its completion.

7. *Machining.* This item involves only the removal of metal, and has little or no relation to the time involved in machine movements.

8. *Manipulating the machine at the end of the cut.* This item includes the fundamental operations necessary to disengage the cutting tool from the work and to bring it to a position where it can be removed or reset for another cut. In general it is the reverse of item 6.

9. *Removing the tools.* This item includes the elements required to loosen the device holding the tool in place and to remove it to the tool stand. In general it is the reverse of item 5.

10. *Removing the clamps and securing devices.* In general this item is the reverse of item 4, except that the elements are performed in reverse order.

11. *Removing the work from the machine.* The elements involved here are the same as those involved in item 2, excepting that they are performed in the reverse order.

12. *Restoring the machine to its normal condition.* The operations comprised in this item are practically identical with those comprising item 1, but in addition it includes the operation of cleaning the entire machine.

Time studies in which the various elements are classified as above permit of the widest use. For instance: The same studies on clamping may be applied to several different types of machines. Work may be held with U-clamps on the platen of the planer, or table of the boring mill, drilling machine or shaper. It makes no difference what machine is involved, so long as the character of the work to be clamped and the relative conditions are the same. The time for clamping should be uniform.

Another example is calipering. The time required to caliper a piece of work depends but little upon the machine in which the work is placed, but does depend very largely upon the size of the work itself. Studies on calipering in one class of machine are equally applicable to other types.

Again, in hoisting and landing it makes but little difference whether the work is landed in the machine on centers, or lowered in position on the table. The weight and distance a piece is to be moved will make quite a difference, and time studies on hoisting and landing, therefore, are classified first with respect to the method of handling—whether by hand, chain, pneumatic, or electric hoist, or crane—second, with respect to weight and, third, with respect to the distance moved. Classified in this manner the different groups of time studies can be combined one with another to fix the time required for practically every class of work. There will, of course, be necessary additional time studies peculiar to the machine in which the work is placed. That is, in addition to studies of hoisting, landing, calipering, etc., applicable to all classes of work, there must be studies in machine manipulation for the different machine tools, such as lathes, planers, millers, shapers, drilling machines, etc., and studies of tool setting for these various machines.

ANALYSIS OF THE GISHOLT BORING MILL

These general considerations being understood, we may now examine the method of analyzing a machine time study. The time studies forming the subject of subsequent articles were made by first dividing the operations on Gisholt boring mills into their fundamental operations such as: 1. Preparation of the machine, including oiling, raising and lowering the rail, swiveling the ram, changing position of the tool post, etc. 2. Manipulation of the machine, including rapid travel of the head and rail, revolving of the turret, operating speed and speed gears, etc. 3. Landing work on the machine. 4. Clamping work. 5. Setting and starting cuts which include some machine manipulation already stated in 2, and some machine elements not stated elsewhere. The studies were made on a series of machines ranging from 30 to 84 inches in size, and all of the operations outlined were studied on each machine.

Each of the fundamental operations comprised in the foregoing sub-divisions was analyzed into its most elementary motions and the sequence of operations from start to finish as revealed by this analysis was tabulated. An example of this is a study made on the turning of chuck jaws end for end. The elements are as follows:

1. Obtain wrench from tool stand.
2. Loosen two $\frac{5}{8}$-inch setscrews in first jaw.
3. Remove jaw from slot.
4. Clean slot.
5. Turn jaw end for end and re-enter it in slot.
6. Set jaw to line on table.
7. Tighten two $\frac{5}{8}$-inch setscrews in jaws.
8. Turn table 120 degrees.
9. Loosen two $\frac{5}{8}$-inch setscrews on second jaw.
10. Remove jaw from slot.
11. Clean slot.
12. Turn jaw end for end and re-enter it in slot.
13. Set jaw to line on table.
14. Tighten two $\frac{5}{8}$-inch setscrews in jaw.
15. Move table 120 degrees.
16. Loosen two $\frac{5}{8}$-inch setscrews in third jaw.
17. Remove jaw from slot.
18. Clean slot.
19. Turn jaw end for end and re-enter it in slot.
20. Set jaw to line on table.
21. Tighten two $\frac{5}{8}$-inch setscrews in jaw.
22. Return wrench to tool stand.

COMBINING OPERATIONS

It has been shown in a previous paragraph that fundamental operations can be combined one with the other to give a complete tabulation of the operations involved together with the time required for any job. In the boring-mill-studies presented in subsequent articles, the following operations have been considered as fundamental to a boring mill.

1. *Preparation.* Oil, raise and lower rail, swivel head to angle, remove from and replace tool post or bar in ram, raise or lower tool post in ram, set chuck jaws on table, remove chuck jaws from table.

2. *Landing.* On centers, by hand; on centers, by hoist; in chuck, vertical, by hand; in chuck, vertical, by hoist; in chuck, horizontal, by hand, in chuck, horizontal, by hoist; on table or platen, by hand; on table or platen, by hoist; on table in V-blocks, by hand; on table in V-blocks, by hoist; in vise, by hand; in vise, by hoist; on arbor, by hand; on arbor, by hoist.

3. *Squaring, levelling and making work run true.* In chuck, in chuck and steady rest, on centers, on platen, on faceplate.

4. *Clamping.* Clamping work in chuck jaws, clamping with U-clamps, clamping with goose-neck clamps, removing work from chuck jaws, removing U-clamps, removing goose neck clamps.

5. *Setting tools in post.* Set tools in tool post in right-hand head for cut on outside diameter: (a) Round nose roughing tool, (b) square finishing tool. Set tools in tool post in right-hand head for cut on face: (a) Round nose roughing tool, (b) square nose finishing tool. Set tool in tool post in left-hand head, tools set for cut on outside diameter: (a) Round nose roughing tool, (b) square nose finishing tool. Set tools in tool post in left hand head, tools set for cut on face: (a) Round nose roughing tool, (b) square nose finishing tool.

The following are common to many types of machines, and must be used in preparing instruction cards for boring mills, planers, shapers, drilling machines, etc.

6. *Manipulation* Change position of head, start

motor, stop motor, start table, stop table, change feed gears, change speed gears, ratchet head back.

It should be noted that items 8 to 12, inclusive, under the preceding head "classification of operations" are also fundamental operations, being the reverse of those given immediately above as applying to a boring mill.

Elementary Times

A word of explanation is in order at this point in regard to the time set opposite the elementary items in the tables that follow. It will be observed that in some instances the time is given to four decimal places of a minute, although the stop watch that was used in taking the studies was subdivided to read only to two decimal places. The results of all of our computations were plotted to a large scale on cross-section paper and smooth curves drawn from which the values appearing in the tables were read. The scale adopted in drawing these curves was so large that it was easily possible to read to four places of decimals. In making up the tables of fundamental and complete operations, however, the limits of practice and of common sense were borne in mind and final results are given only to 0.01 minute. It should be remembered that the results given in these articles were obtained under the conditions of a scientific investigation in which greater refinements were possible than are either necessary or desirable in ordinary shop practice, for this reason also some of the figures were carried to four decimal places.

(To be continued)

A Plea for the Cost Accountant

By George W. Hamilton

It is an indisputable fact that within the past five or six years a new profession has pushed itself into American manufacturing life. A few years ago no one had ever heard of a "cost accountant," but today most of the foremost newspapers and technical magazines present the manufacturer's need for such men.

The old type of conservative manufacturer who believed that any cost system was too expensive to install and operate is fast disappearing, and the demand for adequate and up-to-date cost systems is becoming more and more apparent. There is, therefore, a recognized need for cost accountants, but is there a recognized position in the factory personnel for the qualified, practical, cost accountant?

Before that recognized position can be discussed, a thorough understanding of what is implied by cost or factory accounting is necessary. Cost accounting does not reach the end of its tether in a ledger, or in a set of stores records; it means much more than the computation of employees' earnings or an unrelated analysis of wages; goes beyond the initial stage of collecting labor and material costs data, and should present to the executive body something more valuable than the average monthly statements, which, although very interesting and highly ornate, have no practical reference to the vital issues—sales, costs and production.

Science of Cost Accounting

What, then, is this hitherto dormant science of cost accounting? You will find a multiplicity of answers in any of the standard works of the better known eminent authors, but the average busy manufacturer can seldom find the time or force the inclination to dissect and digest the technical terminology indulged in by most of the professional writers. Even granted the time and inclination, how many already sadly harassed manufacturing executives will attempt to apply the theories or develop the results accruing from any one cut and dried system?

In simple language then, the factory cost system must be concise and practical, it must be an orderly collection of logically related principles and facts worked out in monetary values. It must show exact prime costs; i. e., labor and material, with the overhead expense or burden applied departmentally and absorbed in the cost of the product. A monthly statement of profit and loss should be compiled, showing the profits from operation, according to classes of products if necessary. The system should present periodically reasons for decreases in production, increases in cost, and with the profit and loss statements an inventory value of materials, crude, finished, and in process.

What the Accountant Must Know

To accomplish these ends an intimate knowledge of accounting principles and procedure is necessary. It will be seen, therefore, that the individual in charge of the factory clerical department must be primarily an accountant in the highest and truest sense of the term. He must be able to develop scientifically a burden scheme to be incorporated in and form an interwoven element of the accounting practice of the enterprise. He must be capable of devising and installing, if desired, such methods as will increase production and decrease costs—an incentive wage system for instance. His must be an unmistakable knowledge of what constitutes factory expense; the discrimination between depreciation, repairs and obsolescence falls to his charge. The cost accountant must be relied upon for all manner of statistical reports; the correct classification of labor and material must be done under his supervision. As the responsibility of costing plant repairs, betterments and additions is his, he should enjoy the confidence of the factory manager. If new units of product or changes in design, size or finish are contemplated, his department must be notified of the project so that suitable arrangements can be made to accumulate the cost of the new line or the proposed changes.

The up-to-date factory accountant will develop an intimate knowledge of the various operations necessary to produce the articles, consequently he should be competent through that practical understanding to schedule the production and route it through the required processes.

The payroll of necessity is made up under his guidance and through that branch of his responsibilities an intimacy with the operators is fostered in a slight degree. He must have the confidence of the foremen and workmen, be alert to their many idiosyncrasies, and be able to ferret out the causes of labor unrest.

Should Not an Accountant Be Next to the Manager?

These are only a few instances of the heavy responsibilities of the modern cost accountant. It is natural to assume that the factory is governed by a factory manager or works superintendent. What is more natural than to expect that the cost accountant will rank in the high command next to that executive? The manufacturer's urgent need for factory information other than the average superintendent's general summary suggests it, the accountant's capabilities qualifying him for that recognition, and his responsibilities demand it.

Labor-Saving Coal Handling for the Factory Power House

By Reginald Trautschold

Many factors are now compelling factory managers to consider and plan for the proper handling of boiler coal. This article discusses both machinery and economics. Several new devices and methods are described including "silo" coal bunkers, weighing lorries, conveying scales and a rotary "grizzly." A careful comparison is made of the operation costs of flight conveyors, belt conveyors and pivoted bucket conveyors.

Mr. Reginald Trautschold *has specialized in power-plant design, machine design and factory economics. From 1898 to 1911 he held positions of designer, superintendent of construction, chief engineer and sales manager with several well-known manufacturing firms, including Sprague Electric Company, Marine Engine and Machine Company, Henry R. Worthington, Arnold Sewing Machine Company, Robins Conveying Belt Company and the Intercontinental Engineering Company. Since 1911 he has practiced as a consulting engineer.*

Modern Coal Handling for the Factory Power House

THE economic problem, which has faced the specialist in the handling of fuel for the manufacturer's power house during the past few years, has not been very different from that confronting every other constructor. Equipment has about doubled in price, steel construction has soared to unprecedented heights as pertains cost, concrete and masonry work become expensive and lumber scarce, while the greatly curtailed labor supply commands higher and higher wages. At the same time, the need of adequate coal storage and economy in the cost of handling the coal from the point of supply at the manufacturer's yard to its final disposition on the grates of the all important steam generators have been made more imperative than ever by the scarcity of coal and its high price.

The coal scarcity has made an adequate coal reserve of the utmost importance to every manufacturer, and its high cost necessitates that the fuel be handled about the plant as economically as possible. This condition has tended to make more general the mechanical handling of coal, for no plant, large or small, can now afford to pay the price of manual handling. The importance thus focused on the question of coal handling has resulted in radical changes in the methods employed to store the coal supply and to feed it to the boilers. So effective have been these changes that it would be little, if any, exaggeration to claim that today a boiler plant for a large manufacturing power plant, exclusive of its steaming equipment, could be erected, furnished with adequate coal storage facilities, and equipped with a complete system of conveying mechanisms for handling the coal from the point of receipt at the yards to the furnace grates for less money than the most efficient layout of ante-bellum days. This too, in spite of to-day's high cost of equipment, materials and labor.

Such remarkable result has been made possible by a trip back to the farm and the adoption of certain farm methods, but before considering the latest developments in coal handling and storage for the factory power house, it is of interest to review briefly the changes in power-house operation which have so intimately affected the problem of handling the coal supply.

Overhead Coal Bunkers

The advent of the mechanical stoker was the one factor which, prior to the recent development, had the greatest effect upon coal handling and storage methods. Overhead storage bunkers running the length of the boiler batteries and located so that coal could be drawn directly to the various stokers or to conveniently located floor piles adjacent to the boilers for hand firing was the obvious development. Steel bunkers were at first almost universal, but when the high cost of such construction was better appreciated the use of suspended bunkers of reinforced concrete construction became more general. Usually the bunkers were installed within the boiler building, built over the boiler battery, in an elevated position across the boiler aisle or suspended over the aisle, and this necessitated a tall and expensive building construction, if large storage space was to be provided. It also added to the difficulties of securing proper ventilation and light for the boiler room. However, the construction had certain merits of convenience and represented a considerable advance over the outside coal pile from which the coal had to be transported to the grates as it was required.

The convenience of feeding the stokers, etc., by gravity resulted in the saving of much coal handling, but not so much as was at first anticipated, for in every boiler battery there are always certain boilers which are used more continuously than others or which demand a greater supply of coal. The result is that as the coal reserve in the elevated bunkers lowers it becomes more difficult and finally impossible to feed the grates by gravity. Either it is necessary to trim the bunkers periodically or else take coal from supplied bunker sections and convey it to the boilers which cannot be fed by gravity. This handicap led to the installation of traveling coal lorries, propelled or power driven, for bringing the coal from the more remote coal spouts. The use of coal lorries was stimulated through their convenience. The weigh-lorries—an improved form, is a device by which the coal can be accurately and conveniently measured before being fed to the stokers, so that in the efficiently operated power plant all coal is so handled and the direct gravity spout feed, if retained, is only used in the case of emergency.

The overhead coal bunkers were supplied with coal by any of the ordinary conveying and elevating systems. The coal was elevated by bucket elevator, skip hoists, hoisting towers, inclined belt conveyors, etc., and distributed over the bunkers by tripper lines, flight conveyors, bucket carriers, etc. The pivoted bucket carriers for elevating and distributing the coal to the bunkers and also to collect the ashes from beneath the grates and elevate them to an overhead ash hopper from which they could be chuted to wagons or freight cars for subsequent disposal was a scheme of considerable popularity. Such an installation, in spite of its rather inefficient consumption of power and the high cost of equipment had a number of advantages to recommend it—particularly for the comparatively small power house. In larger plants, more diverse equipment usually gave promise of greater economy and some quite elaborate systems were evolved.

Such, in brief, represented, until a few years ago, about the most efficient methods of handling and storing coal for the factory power house. Of course, some systems of conveying equipment were more efficient and economical than others, as they are at the present time. As carriers, the belt conveyor, with its surprising capacity and economy in the use of power, handled more coal at less expense than any other system, for the comparatively short transportation distances necessitated in a factory power house and its surrounding property; a fact well worth noting.

OUTSIDE COAL BUNKERS

The change to the latest coal storage scheme was not made all in one jump, the location of the coal storage bunkers without the power house building forming an important intermediate development. These bunkers were quite similar to those suspended over the aisles between batteries of boilers and were either of steel or reinforced masonry construction. They were supplied with coal much in the same manner as the inside bunkers, except that the pivoted bucket carrier system for handling both coal and ashes was not feasible unless the boilers were grouped in batteries along the outer wall of the boiler building. Coal lorries for distributing the coal to the various boiler units—incidently weighing the coal in transit became a necessary adjunct to such coal storage, for the direct gravity spout stoker feed was impractical by reason of the expense attendant upon locating the bunkers at elevation sufficient for gravity feed.

The very decided advantage of permitting a much lower, lighter and cheaper boiler house building—a one-story affair—was secured in this general type of construction, but the relative cost of such bunker construction would be unduly great in these days of high building costs. For a large modern factory plant, the necessary steel bunker capacity would cost close to $50 per ton of coal storage space, while for a bunker of reinforced masonry the cost would be nearly half as great—say, in the neighborhood of $20 per ton capacity. These approximate figures will, of course, vary considerably, but they are typical and represent the average cost of a number of outside bunkers built quite recently. In connection with these general estimates, one quite reliable peculiarity deserves notice. The cost of the supporting structure for the bunkers is very nearly the same as the cost of the bunkers themselves.

Though these outside bunkers are supplied with coal, as a rule, in ways similar to those resorted to for charging inside bunkers, the results secured by the use of shuttle belt conveyors has been so uniformly satisfactory that this adaptation of the belt conveyor is coming into much more general use than formerly. The scheme is not new, having been used for years in charging coal pockets. It consists essentially of a comparatively short reversible belt conveyor mounted on a movable supporting structure of the nature of a truck, by which the belt conveyor may be extended in either direction, manually or by power automatically. The coal is elevated and delivered to the shuttle-conveyor, two-way feeding chute at a point about midway of the length of the bunker to be charged. This shuttle conveyor, which in such an installation needs to be about half as long as the coal bunker, in order to reach all storage parts with its end discharge, is extended so as to discharge wherever desired in one half section of the bunker and then, by reversing its direction of travel, the other half section of the bunker can be supplied with coal over the other end pulley. Not only can such a shuttle conveyor serve a bunker about twice its length, but the expensive tripper lines or "fixed dump" constructions required to discharge a fixed belt conveyor along its length are avoided. The economy represented by this simple construction is marked. The cost of a shuttle conveyor to serve a bunker is but 40 to 50 per cent. as great as that of a tripper line conveyor extending the full length of such bunker.

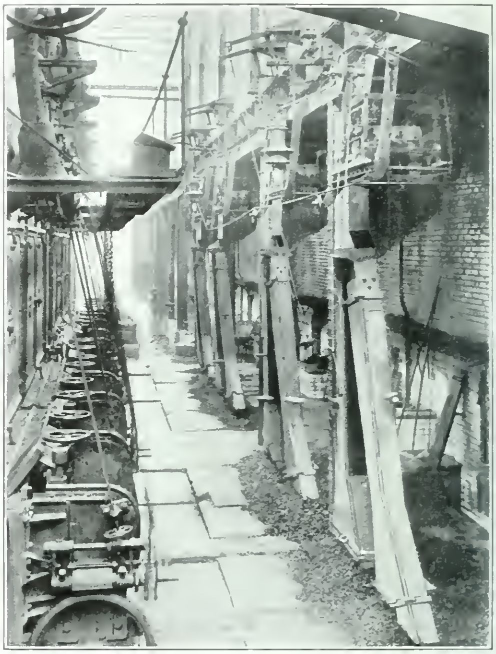


FIG. 1. WEIGH-LORRIES CHARGED FROM AN OVERHEAD BUNKER DELIVERING TO BOILER ROOM FLOOR

The high and expensive boiler room construction due to the overhead bunkers is quite apparent.

THE SILO STORAGE

Journeying now to the farm, the latest development in coal storage will be noted in the silos the farmer employs for his corn or grain. These deep cylindrical bins on stilts, which revolutionized the construction of grain elevators in the west, have solved the problem of economic and convenient coal storage and give every indication of also revolutionizing power-house construction. The fact that an upright cylindrical tank has a maximum volumetric capacity for the surface area of its sides is no new discovery—the form has been utilized for years for water and gas tanks—nor is there anything new in the knowledge that side strains are minimized, permitting much thinner walls than if the tank was horizontal, but it is a new form to adopt for coal storage. Obviously, a silo of reinforced concrete can be erected, not only with a minimum amount of material, but more economically for forms, labor and time than any other shaped bunker of equal capacity. Once the supports have been erected, a silo of several hundred tons coal capacity can be poured by a few laborers in a remarkably short time. A system of moving forms, but a few feet in height, can be employed and the pouring of the concrete carried forward continuously. As the forms rise slowly, the exposed concrete is firm enough to stand unsupported, while that poured in at the top is, of course, quite plastic.

The thickness of the silo walls (reinforced concrete) is made one-fiftieth of the diameter of the silo (with a minimum thickness of seven inches); the bottom of the silo is made flat, and the dead storage space at the bottom is compensated for by sur-charging; and if supporting posts are more than 25 feet in height (above the ground level) it is cheaper to make them of steel than of reinforced concrete. The cost of the silo supports is approximately the same as that of the silo tank, so a pretty close estimate of the cost of the completed silo may be arrived at if a price for plain reinforced concrete work per unit is known.

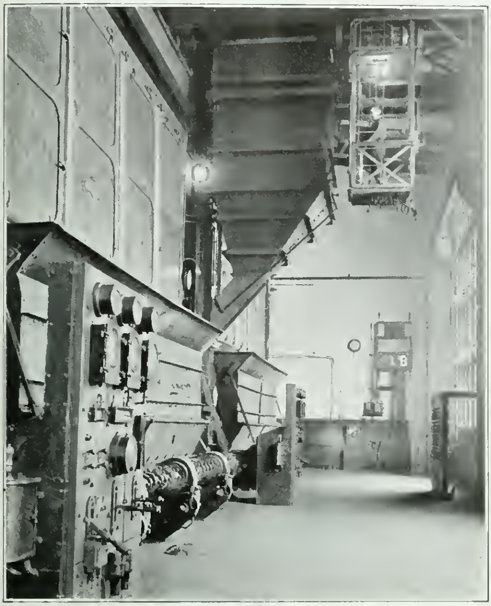


FIG. 2. WEIGH-LORRY CHARGED FROM AN OUTSIDE STORAGE DELIVERING DIRECTLY TO THE STOKER

The low, well lighted and comparatively cheap construction of boiler room made possible by outside bunker storage is well illustrated.

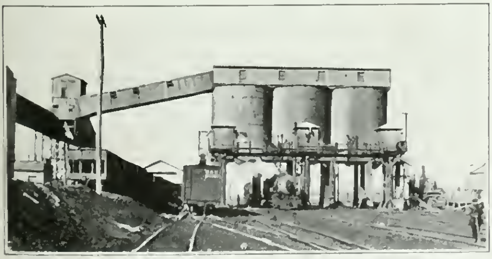


FIG. 3. LOCOMOTIVE COALING STATION AT CROXTON TERMINAL, ERIE RAILROAD

Engineers: Robins Conveying Belt Company, New York. Silo Contractors: General Contracting and Engineering Company, New York.

The expensive supporting structures of the silo are necessitated by the fact that weigh-lorries, which are really nothing more than fairly commodious traveling weighing hoppers, discharging through bottom spouts directly into the stokers, or else, through the longer spouts necessary for ample clearance for the passing lorry, to piles on the boiler room floor, have to pass under the bottoms of the silos to obtain their charges from bottom silo gates, or, if the silos discharge directly to the stokers or floor, they have to clear the roof of the one-story boiler building.

The weigh-lorries run on overhead tracks and in the larger sizes are operated by attendants riding in cages that form part of the lorry construction, much as heavy traveling cranes are operated. Smaller lorries may dispense with the operator's cage and be guided by hand from the ground or, as is the case in some of the most approved lorries of limited capacity, be electrically controlled from switches conveniently located for each boiler attendant. Their convenience and effectiveness is very marked. In one large installation, employing man-controlled weigh-lorries, *one* lorry with its traveling attendant of *one* man cares for boilers of 60,000 kilowatts. That is, *one* man weighs the coal and feeds boilers aggregating a capacity of 60,000 kilowatts.

PIONEER COAL SILOS

Obviously suitable as are silos for power house coal storage, the first coal silos were constructed for locomotive coaling stations, and for some of the recently built retail coal pockets. One of the most efficient examples of silo construction is the coaling station of the Erie Railroad at the Croxton Terminal recently completed. The illustration of this station, Figure 3, shows three 400-ton silos, 20 feet in diameter by 30 feet in height, charged by a system of belt conveyors leading from a track hopper to which the coal cars discharge. The general scheme for retail coal pockets is very similar, except that the silos do not have to be carried on quite such high supports, can frequently be grouped more compactly, and the design and arrangement of the coal handling equipment suited to local conditions.

SILOS FOR FACTORY POWER PLANTS

The silo construction of coal storage for the factory power plant differs in no way from that for locomotive coaling stations or retail coal pockets, but their location is governed by the type of boiler building, the methods employed for charging the stokers or supplying the coal to the grates, and the kind of fuel fired—whether a straight coal or a mixture of anthracite and bituminous.

With a one-story boiler building — the economic construction which makes the silo coal storage superior to any other type of fuel bunker, representing, as it does, a very considerable saving in building cost—the silos, though necessarily carried on heavy supporting structures, are usually built apparently upon the roof of the building, like so many large water tanks. If the plant is operated on only one kind of fuel, the line of silos, should there be a number of them as is customary, follows the boiler battery lines to secure the convenience and economy of charging the stokers by gravity.

In large plants, where a mixture of coals may be advantageously fired or where weigh-lorries are used exclusively for feeding the stokers, the silos can frequently be located to better advantage a short distance away from the boiler building, but so situated as to be about equidistant from the most remote boilers, in order to minimize the travel of the weigh-lorries. Various grades of coal may be accommodated in the different silos and mixed in the weigh-lorries as such transporters are charged. When this arrangement is advisable, the silos should be built in compact groups of four, six or nine, as the space enclosed by four tangent silos furnishes a storage space equivalent to approximately one-third of that of one of the silos and at practically no expense, for the expense entailed in extending the bottoms of the silos over this enclosed space is lost sight of in the bill for the silos proper.

Another advantage of the silo construction is that in plants employing a vacuum system or a steam jet for disposing of the ashes from the grates, the space enclosed by abutting silos or a chamber within a silo may be used as a storage pocket for the ashes. Also in installations where the silos follow the line of the boiler batteries and are charged with a pivoted bucket carrier also disposing of the ashes, a compartment in one of the silos may be used as an ash bin.

Charging the silos presents no unusual conditions, for any type of coal handling equipment suitable for other varieties of bunker constructions, coal pockets, etc., can be used—the choice governed by local conditions or, as is too often the case, by the persuasive arguments of the conveying machinery salesman—but reclamation is by either direct gravity discharge or through the agency of weigh-lorries. The latter method possesses the advantage of providing an accurate measure of the coal consumed by the various boilers and wields a powerful influence in economic fuel consumption. At the same time, the weighing of the coal as fired has stimulated the practice of weighing the coal put into storage, so that an accurate record of input and output is maintained in many of the modern factory plants—in fact, the practice has become almost as general among manufacturers as among the central stations, whose profitable operation is so dependent upon the efficiency with which fuel is consumed: its latent energy transformed into kinetic—their product being virtually a direct product of the fuel burned.

Automatic Weighing Devices

A very substantial economy can be realized in measuring coal input by weighing the coal as it is being transported and delivered into storage, and devices for accomplishing this form a valuable adjunct to the systems for coal handling in the up-to-date factory power house. Two such mechanisms, operating on entirely different principles, are deserving of special attention, as the accuracy with which they calibrate is rapidly winning for them a place among the requisites of a modern coal handling plant. One, the Merrick weightometer, employs mechanical principles for recording the amount of material carried on a belt conveyor, bucket elevator, or other continuous transporting mechanisms; while the same service is performed by the electric conveyor scales by a system of electrical resistance control for a dynamo whose voltage is maintained proportional to the speed of the carrier travel. Both of these continuous weighing devices are extremely sensitive and accurate to within a fraction of one per cent.

The Merrick weightometer, Figure 4, consists essentially of a pair of weighing levers, connected to a scale beam—much on the principle of the ordinary platform scale—from which a short section of the carrier is suspended. The weight of the load on this suspended section of conveyor, regardless of its distribution, is counterbalanced by a float in a bath of mercury. A variation in the load carried by the conveyor raises or lowers the float in the mercury, which motion is transmitted to a totalizing mechanical integrator by a connection from the end of the scale beam. The travel of the carrier is also transmitted to the integrator from a pulley or sprocket driven by the return run of the conveyor, the product of the two factors affecting the integrator—weight and speed—causing its recording member to register continually the weight passing over the carrier. The volume of coal passed over the conveyor is indicated by a register calibrated in tons or other convenient units, and a magnetic counter can be installed to duplicate the reading of the scale registered at any other desired point, as, for instance, in the superintendent's office.

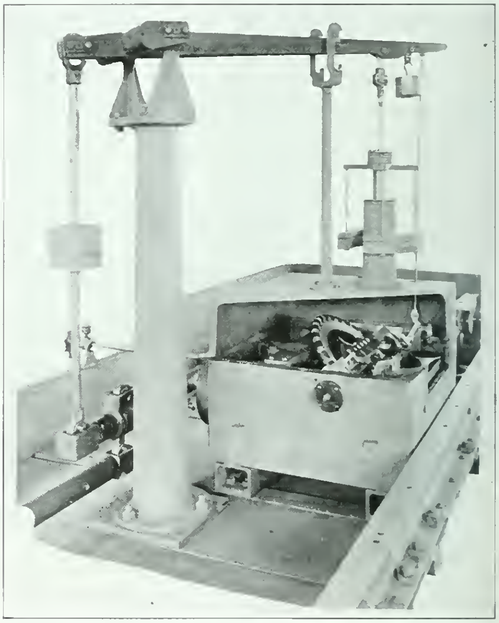


FIG. 4. MERRICK WEIGHTOMETER WITH SIDE OF CASING REMOVED
Built by Merrick Scale Mfg. Company, Passaic, N. J.

The electric conveyor scale, Figure 5, also utilizes a short section of the conveying mechanism suspended from scale beams, but in somewhat different fashion. A short length of the carrying section of the conveyor is suspended on one side of the fulcrum and a corresponding length of the return run from the scale beams on the opposite side of the fulcrum. This construction, when the carrier is delivering coal, causes the tare weight to be automatically deducted and the scale self-balancing against the actual load carried. A cylindrical plunger, partly immersed in mercury, counterbalances the load on the carrier much as in the Merrick weightometer, but the recording of the load carried is entirely different. The operation of the apparatus is based on the principle that if the voltage of a small dynamo driven by the suspended section of the carrier is maintained proportional to the conveying speed, the current generated can be made to vary with the weight of the coal passing over the carrier. A rheostat is connected to contact points in the mercury column and as the mercury rises or falls with the displacement of the plunger counterbalancing the weight of coal on the carrier, the resistance through the rheostat changes proportionally and, therefore, the current delivered by the dynamo is directly proportional to the load passing over the conveyor. An electric meter calibrated to register in units of weight records the service of the conveyor and can be placed in any convenient location.

Recent Development in Coal Screening

In the power house operating on soft coal, receiving run-of-mine shipments, the careful screening of the coal before delivery to the coal "cracker" has always presented more or less difficulty. Fines in the crusher unnecessarily reduce the capacity of the machine, result in the waste of power and represent so much useless work. Vibratory screens and ordinary grizzlies do not perform the service satisfactorily unless the screening plant is quite elaborate, while rotary screens have too limited a capacity for effective service in the modern power plant, but the rotary grizzly, illustrated in Figure 6, on page 452, would appear to solve the problem. This grizzly consists of a series of notched cast-iron discs loosely mounted on a succession of square shafts, all rotated at the same speed by a motor, or, when the grizzly discharges to a piece of moving equipment, by a direct drive from the conveyor. The play of the discs on the shafts is sufficient to give them a "wobbly" motion as they revolve and this develops a kneading action which thoroughly separates the fines from the coarse coal, at the same time the discs' rotary motion carries the large coal over the grizzly.

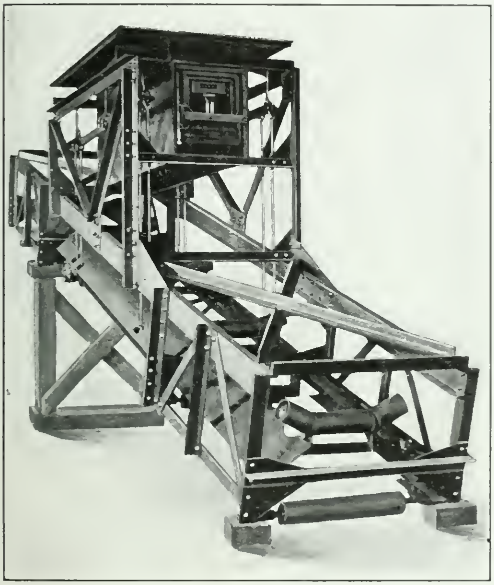


FIG. 5. ELECTRIC CONVEYOR SCALES
Electric Weighing Company, New York.

These rotary grizzlies when feeding directly to the crusher are customarily mounted at an inclination of seven degrees, and the periphery speed of the rotating discs made that at which the lump coal can be most effectively delivered to the "cracker" for the machine to maintain maximum output. When delivering to a charging conveyor, the rotary grizzlies are inclined at the same angle and the periphery speed of the discs made the same as that of the conveyor. The coal is thus delivered at the speed of the conveyor, eliminating all shock of impact and assuring against breakage.

Operating Costs and Economic Selection of Equipment

With the present abnormally high cost of conveying equipment, the labor market so unsettled and the prices of all supplies changing almost over night, any elaborate discussion of costs, for equipment or operation, can be of little value. Nevertheless, the importance of conveying and elevating equipment in economically handling the coal supply for the factory power house is now so great that added interest is given to the economic selection of the advisable system to install. The average factory management, while only incidentally interested in detailed costs of equipment, data on the amount of power consumed by various types and sizes of conveyors, etc., etc., is chiefly concerned in the amount it may be expected to pay for handling its coal supply during the year by this or that system of conveying machinery.

Though itemized costs on coal handling equipment cannot be presented very well at this time, a sufficient amount of reliable data pertaining to cost of operation prior to the abnormal inflation in prices can be cited, from which the progressive manufacturer who has kept in touch with the increases in equipment cost, wages, etc., can form a trustworthy idea of the cost of handling his annual coal supply by certain of the suitable mechanical systems.

The total annual cost of handling the coal supply includes three classes of expense, into which every expenditure to be anticipated can be grouped. First, there is the fixed charge account, to which is chargeable the burden of interest on investment, taxes, insurance, etc., and such allowances for depreciation, attendance, etc., as experience has shown may be required during the year, irrespective of the amount of service rendered by the equipment—i. e., tonnage handled. The second account includes the operating expenses, other than those for power or incidental thereto and those charged to "Fixed Charges"; the third, the cost of power and all expenses entailed which depend upon the use of power. Obviously, the second class of expense depends upon the tonnage handled, while "Power Expenses" are affected by both the tonnage and the unit cost of power.

Although there are numerous systems of conveying machinery which could be employed for handling the coal supply, and many more combinations of such systems, it is still possible to divide the choice of suitable systems into a few types which are comprehensive and typical. Two distinct services are required of nearly every coal handling installation, i. e., to carry the coal over horizontal stretches and to elevate it. Both services can be discharged by flight conveyors, belt conveyors and pivoted bucket carriers. Elevating alone can be most cheaply performed by a bucket elevator. The ordinary coal handling proposition of the factory power house, then, calls for one of four distinct systems of conveying equipment: flight conveyors, belt conveyors, pivoted bucket carriers, or a bucket elevator in combination with some type of conveyor to distribute the coal to storage, whether the storage be of the modern coal silo class or overhead bunkers.

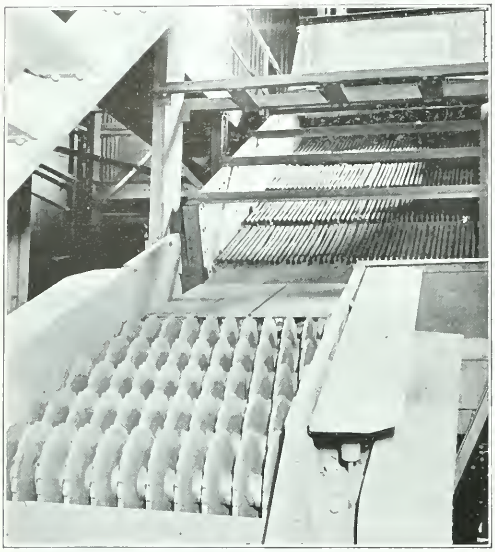


FIG. 6. ROBINS ROTARY GRIZZLY

As only the most efficient equipment for the various systems need be considered in a general discussion, flight conveyors may be limited to the double strand type with roller flights, and the conveying equipment required when employing bucket elevators to elevate the coal to belt conveyors. Certain limitations are also necessary in the systems which render both elevating and conveying services with the same type of equipment, so, in a straight flight or belt conveyor system, it may be assumed that on the average there is a rise of 20 feet in each 100 feet of travel, and that in a pivoted bucket carrier installation the coal is elevated a foot for each three feet it is conveyed horizontally.

Expressed in the total cost per ton-mile, the average expense for handling the coal supply per year in a number of typical manufacturing plants, divided into the three major accounts, is given for flight conveyors, belt conveyors and pivoted bucket carrier installations in the following table. These empirical values include all expenses chargeable to the actual operation of the respective systems, but do not include expenses contracted in building supporting structures, etc., or in maintaining such property in good repair, and interest charges on erection expenses are not included under "fixed charges," as all such expenses are customarily charged against general plant maintenance.

A variable factor enters into the proportion of "fixed charges" carried per ton-mile, as such charge is dependent upon the number of hours per year the coal handling system is in actual operation, i. e., the total charge should be apportioned to the total amount of coal handled. In the case of "power expenses," the unit cost of power is segregated as a factor subject to variation.

TABLE 1.—ANNUAL OPERATING COSTS IN DOLLARS PER TON-MILE

Equipment	Fixed Charges	Operating Expenses	Power Expenses
Flight Conveyors (including 20% elevation)	17.5/N	0.55	5.30 Pc
Belt Conveyors (including 20% elevation)	109.5/N	0.15	2.15 Pc
Pivoted Bucket Carriers (including $33\frac{1}{3}$% elevation)	520.0/N	0.40	2.65 Pc

N = hours per year equipment is in operation
Pc = cost of power per horsepower

In the case of a combined bucket elevator and belt conveyor installation, a somewhat different procedure of arriving at a figure for the annual cost of handling coal over the combined system is advisable, on account of the complicity of the calculations involved by the necessity of considering two distinct types of equipment. In fact a method of estimating based on proportional comparisons of belt conveyor calculations gives results sufficiently accurate for forming a fair idea of relative costs.

In an inclined belt conveyor system, with the maximum practical angle of inclination, about 93 per cent. of the total travel of the belt is horizontal and but 7 per cent. vertical. That is, for a belt conveyor to elevate 7 feet it would have to traverse a horizontal distance of about 93 feet. On the average, it costs about one-third more to elevate a given distance by an inclined belt conveyor than it does by a straight bucket elevator, when proper credit is given to the mechanical efficiencies of the respective systems, costs, depreciation, labor, power consumption, etc. Three-quarters of 93 per cent. of the total cost of a belt conveyor system of equal coal handling capacity will represent, then, the total cost of operating the bucket elevator. To this figure it is necessary to add the cost of operating the distributing belt conveyor of the combination system. This cost, as a rule, will be about 10 per cent. more than the 7 per cent. of the total belt conveyor system cost not considered in the elevating service. This approximation method of reaching the annual cost of a bucket elevator-belt conveyor system is apt to favor the combination system in respect to cost of operation.

An example or two of the use of these empirical methods of arriving at total handling expenses will establish their value. It may be assumed, therefore, that a power house consumes some 50,000 tons of coal a year and the distance of the extreme end of the proposed conveying system from the track hopper, or point of coal supply, is in the neighborhood of 528 feet. That is, the coal handling proposition entails a conveying service of 5,000 ton-miles per year. It may be further assumed that coal is received at the plant ten times a year, in consignment averaging 5,000 tons, and that a coal handling system of 100 tons per hour capacity is contemplated. These conditions would necessitate active operation of the coal handling system some 500 hours per year.

Obviously, either a flight conveyor or a belt conveyor system could be installed, and but a glance at the preceding table will indicate that the cost of installing the belt conveyor system (initial cost) is considerably the heavier. The cost for service during the year, on the other hand, materially favors the belt conveyor installation. See Example 1.

Should the property of the manufacturer be limited, or local conditions necessitate a more compact layout,

Example 1. Required:

Annual cost of handling 50,000 tons of coal per year over a flight conveyor system and over a belt conveyor system.
Length of systems 528 feet and capacity 100 tons per hour.
Cost of power 2 cents per horsepower.
Service, 50,000 × 528 ÷ 5280 = 5,000 ton miles
Hours of 50,000 ÷ 100 = 500 hr. per year
Operation

Flight Conveyor System Annual Cost:
$5{,}000\ (17.5 \div 500) + 0.55 \times 5{,}000 + 5.30 \times 5000 \times 0.02 = \$3{,}455$, or 6.91 cents per ton.
Belt Conveyor System Annual Cost:
$5{,}000\ (109.5 \div 500) + 0.15 \times 5{,}000 + 2.15 \times 5000 \times 0.02 = \$2{,}050$, or 4.10 cents per ton.

Example 2. Required:
Annual cost of handling 50,000 tons of coal per year over a pivoted bucket carrier system.
Length of system 264 feet and capacity 100 tons per hour. Cost of power 2 cents per horsepower.
Service, $50{,}000 \times 264 \div 5280 = 2{,}500$ ton miles
Hours of $50{,}000 \div 100 = 500$ hr. per year
Operation
Pivoted Bucket Carrier System Cost:
$2{,}500\ (520.0 \div 500) + 0.40 \times 2{,}500 + 2.65 \times 2{,}500 \times 0.02 = \$3{,}733$, or 7.47 cents per ton.

Example 3. Required:
Annual cost of a combination bucket elevator and belt conveyor system, governed by the conditions of Example 1, excepting that the elevator rises directly from the track hopper and discharges to the distributing belt conveyor.
Elevator Costs:
$2{,}050 \times 0.93 \times 0.75 = \$1430$
Conveyor Costs:
$2{,}050 \times 0.07 \times 1.10 = \$158$
Annual Cost $= \$1588$, or 3.17 cents per ton.

location of the track hopper in closer proximity to the power house might make the installation of a pivoted bucket carrier a promising solution of the coal handling problem. In such a case, the service could be materially cut—say to 2,500 ton-miles per year—but the operating hours, capacity of system, etc., remain the same. The cost of annual coal handling with such an installation would be (see Example 2) somewhat more than that entailed with a flight conveyor system, and considerably more than the belt conveyor installation. However, the ashes of the plant could be cheaply handled by the pivoted bucket carrier, with practically no additional expense, other than that for power. If 5,000 tons of ashes were handled per year, this would mean they could be put in the ash bin at an expense of but a few dollars per year, power commanding a price of 2 cents per horsepower.

The annual cost of operating a combined bucket elevator and belt conveyor system of equal capacity, basing calculations on proportional comparisons with the cost of the belt conveyor system, would be in the neighborhood of $1600 per year. See Example 3.

The foregoing computations are all based on costs current in the days preceeding the outbreak of the war and to be of any value today must be modified to meet existing conditions. At present, equipment costs approximately double what it did before the war, so that the "fixed charges" would also have to be about doubled. "Operating expenses" have increased—say, 75 per cent.—so the cost of coal handling by the respective systems today would be, for the flight conveyor installation, approximately $5,825 per year; for the belt conveyor, $3,771; for the pivoted bucket carrier, $6,016; and for the combination bucket elevator and belt conveyor system about $4,512 per year. All power costs are taken as having increased to 2½ cents per horse power.

The examples cited are not intended to classify the respective economic values of the different coal handling systems, for different requirements as to tonnage, distances of transportation within the manufacturer's property, cost of power, etc., might show quite different rankings, but they are advanced to illustrate the use of methods whereby the manufacturer without an intimate knowledge of conveying equipment can form a reliable opinion of the best system to install for his particular coal handling problem.

Typical Mechanical Handling of Miscellaneous Articles

By A. B. Proal, Jr.

Many manufacturing plants are facing the problem of handling a volume of miscellaneous articles by mechanical means. The author lays down the principle that machinery cannot be designed to handle promiscuous material, and then shows several typical installations for handling classified material taken from representative industries.

Mr. A. B. Proal, Jr., *has been with The Robins Conveying Belt Company for some twenty-five years as engineer and expert on conveying and elevating machinery. During that time he has been the responsible engineer in charge of many of the largest conveying and elevating machinery installations in the United States, South America, Europe and South Africa.*

It is absolutely impossible, and I say this without the slightest hesitation, to design machinery that will successfully handle promiscuous material. A great deal of time has been spent in trying to work out some method of handling freight in terminal warehouses and it has been found practically out of the question, except by segregating material into approximately uniform sizes. Where material is to be handled just as it comes from cars—that is all sorts and sizes of materials together—or where it goes from a factory into cars or where it is handled around the factory, the only practical way to accomplish the handling is to put the material in skips, boxes or crates, which can be picked up by means of telphers and thus transferred from point to point. Such unit system is the only solution so far reached to the problem of handling unsorted material. Where a continuous system of conveying is desired the material must first be sorted into sizes. It makes little difference to the conveyor man designing a layout how much the packages vary in weight, provided some sort of uniformity exists in the matter of size. Once properly sorted, material may be handled continuously by a great many kinds of endless conveyors.

AN UNLOADING AND RELOADING CONVEYOR

An interesting system of conveyors has been worked out for the American Linseed Company. See Figures 1 to 5. Flaxseed in bulk is received from boats at the dock and delivered on to an 800-foot troughed belt which carries it through an enclosed gallery to the mill. Here the raw material passes through various processes and the meal is finally pressed into cakes for reshipment. Reloading the vessel, which is carried on while the unloading is still in process, is accomplished by the same belt conveyor, the pressed meal cakes being returned to the dock on the flat return belt. Thus is doubled the effectiveness of this most effective type of conveying apparatus, while cost of operation is increased practically not at all.

For transferring the oil cakes from upper to lower floors, inclined chutes, discharging onto tablelike sections of ball-bearing, gravity roller carriers are employed. These receiving carriers, or tables, are portable, so that the oil cakes may be landed wherever desired, for inspection or stacking.

For delivery to the boats, the oil cakes are loaded on to the out-going return run of the long conveyor belt, via a slat conveyor which carries them up a slight grade to an inclined feeding chute of the spiral type, circling about the receiving chute at which the raw flaxseed is delivered.

Thus, by utilizing a long belt conveyor, a few chutes, a simple slat conveyor and a few sections of standard gravity roller carriers, 125 tons of flaxseed per hour may be brought from the end of a dock to the mill, a distance of over one-eighth mile, pressed into cakes, the oil reclaimed and the pressed cakes reloaded on boats for reshipment, all with practically no manual handling.

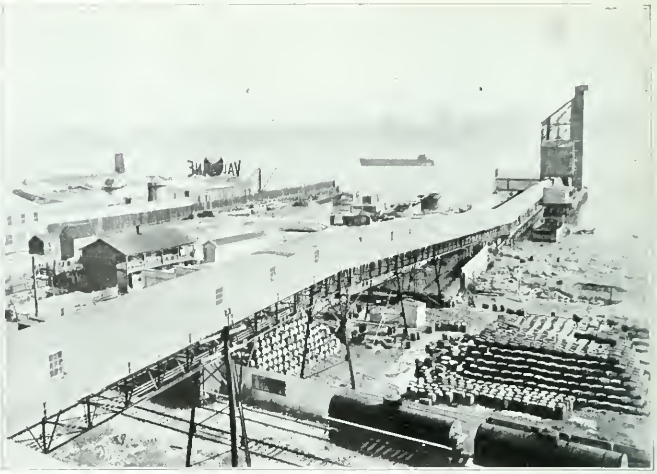


FIG. 1. 800 FOOT BELT CONVEYOR FOR HANDLING FLAXSEED TO AND FROM VESSELS

Inclined Belt Bucket Elevator

Where materials in bulk or small packages are to be handled from one level to a higher one, the inclined belt bucket elevator may often be used advantageously. When handling loose material, the buckets pick up the load and the supporting belt plays little part other than to prevent spilling from overcharged buckets. When small packages are to be carried, however, the belts act as the principal carrier and the buckets serve simply as cleats to prevent any sliding backward of the packages. The buckets may, of course, act as containers for a few extra packages. Such an installation is shown in Figure 6.

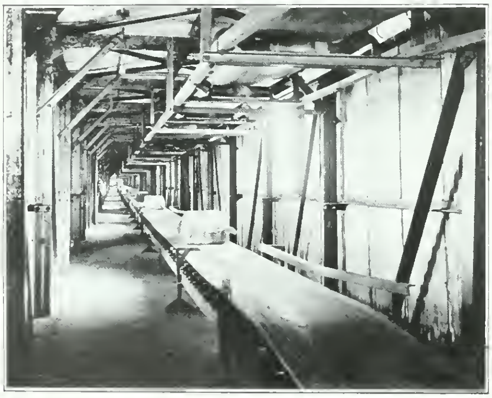


FIG. 2. LINSEED OIL CAKES RETURNING TO DOCK ON LOWER RUN OF CONVEYOR
Troughed Belt Carrying the Bulk Flaxseed is shown overhead

A very ingenious piece of apparatus has been installed by the American, Adams and Wells Fargo Express Companies in their buildings in and about New York, Chicago and San Francisco, for the purpose of sorting packages and delivering them to different points. One such installation is pictured in Figure 7. Wagons of unsorted material, such as is collected by any express company about a city, are unloaded along the tail section of a 400 or 500-foot flat belt conveyor. This conveyor runs from the unloading platform to a weighing, billing and sorting room on the floor above. The small packages, those not exceeding 24 inches in size or 40 pounds in weight, are thrown on to the belt conveyor which is provided with skirt boards running its entire length to prevent the packages falling off in flight. The larger packages are piled on the delivery platform and are subsequently handled by trucks. As the packages on the conveyor reach the end of their flight, they fall over the head pulley of the conveyor on to a revolving cone around which men are stationed whose duty it is to pick off the packages, weigh them, bill them and then drop them into conveniently placed bins. From these bins the packages are packed into trunks and loaded on movable slat conveyors for delivery to the trains on the floor below.

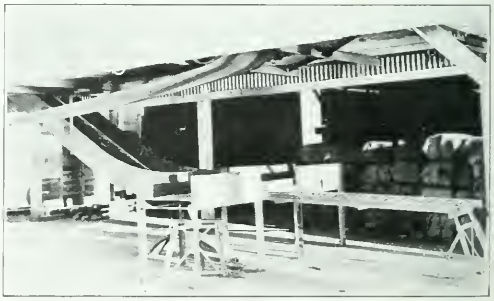


FIG. 3. INCLINED CHUTE DELIVERING ONTO PORTABLE BALL BEARING GRAVITY ROLLER TABLE

As an instance of the saving effected by the installation of such a system for handling and sorting packages, it is interesting to note that during the rush of the Christmas holidays one of the big express companies dispatched packages with 30 men that, previous to the

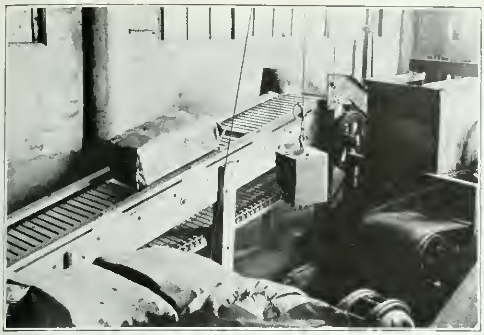


FIG. 4. INCLINED SLAT CONVEYOR DELIVERING BALES TO MOUTH OF FEEDING CHUTE

installation of this equipment could not have been handled by less than 300 men. These 30 men, with the aid of such an installation as has just been described disposed of as high as 12,000 packages an hour.

Manufacturing plants of many kinds might find the installation of a scheme of this character of great value and it is also exceedingly adaptable to the necessities of department and other large stores.

THE FLAT BELT CONVEYOR

Cement mills offer a field for advantageous use of a large variety of conveyor equipment. Cement in bags is most suitably carried on flat belt conveyors. Finished cement in bulk and the raw ingredients used in its manufacture are better handled by troughed belts. Where wet shale or marl is to be handled, chain or flight conveyors are found most efficacious, while for handling the clinkers at such plants, gravity bucket conveyors are nearly always used.

In any such installation, in fact in any conveying proposition, where manual handling or assistance in handling may be needed, the elevation of the conveyor is frequently of as much importance as the service the conveyor performs. For instance, in the illustration showing the handling of cement bags to be loaded onto freight cars, Figure 8, the elevation of the conveyor is such that in stacking the bags on the freight cars, a minimum amount of handling will be required. The bags pass from the end of the conveyor to an inclined leading plank whose inclination may be altered to deliver the bags of cement at any elevation from the car floor level to about that of a man's shoulders. Much back breaking work is thus avoided.

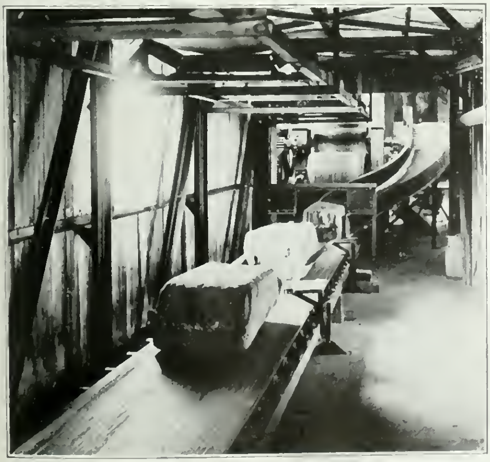


FIG. 5. OIL CAKES DELIVERED TO BOTTOM STRAND BELT CONVEYOR WHILE MATERIAL IS DISCHARGING FROM UPPER STRAND

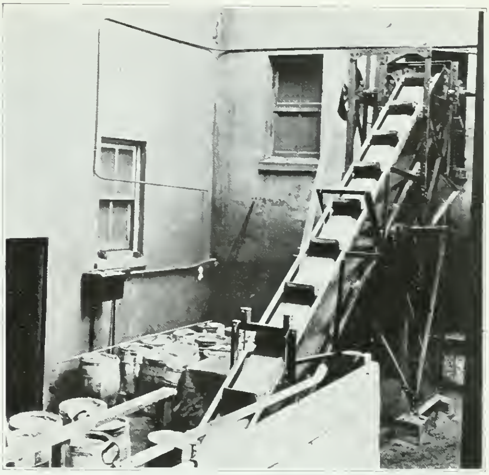


FIG. 6. BELT BUCKET ELEVATOR FOR HANDLING LOOSE MATERIAL AND SMALL PACKAGES

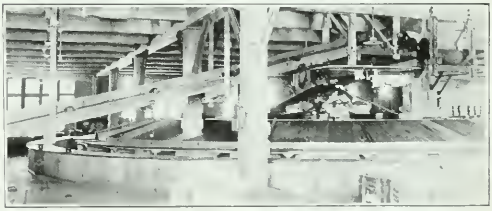


FIG. 7. ROTATING CONE FOR SORTING BUNDLES RECEIVED FROM INCLINED PACKAGE BELT CONVEYOR

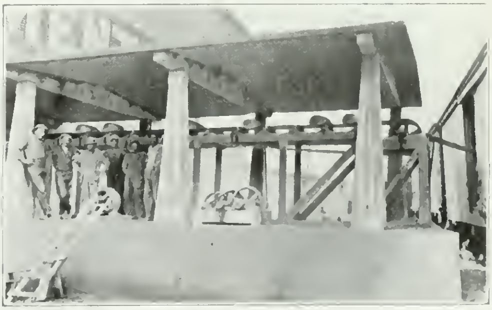


FIG. 8. FLAT BELT CONVEYOR HANDLING BAGS OF CEMENT FROM MILL DIRECTLY TO CARS

Handling Promiscuous Material

The last illustration, Figure 9, depicts what is probably the most successful attempt to handle promiscuous material by conveying machinery. It is a typical view of what is going on every day at one of the ash disposal plants about New York City. Unsorted material is certainly being handled here with some degree of success upon a flat belt conveyor protected by broad, inclined skirt boards. But excepting in a refuse disposal plant such service could have little demand. However, the illustration well exemplifies promiscuous material handling under unusually favorable conditions. In no industrial establishment would such heterogeneous load be countenanced, yet it is this very untidiness and conglomeration which makes the mechanical handling of the refuse possible. The smaller and heavier refuse, which, in reality, forms the major part of the load carried by the conveyor, settles on the belt and forms a bed on which rides, for the most part, the more varied, larger rubbish. Little attempt is made to sort this rubbish when it reaches the end of the conveyor.

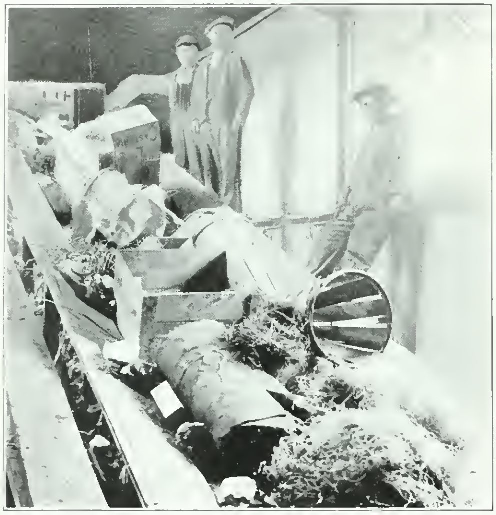


FIG. 9. FLAT BELT CONVEYOR WITH SKIRTED SIDES FOR HANDLING REFUSE

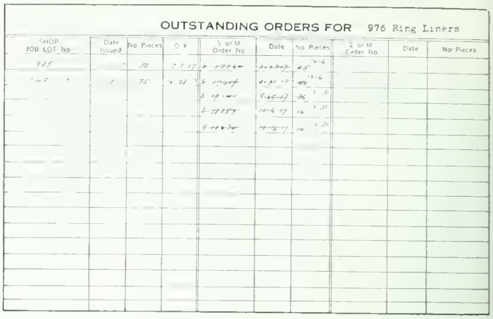
If such a conveyor should prove of any value in the average industrial plant, the handling of promiscuous material could be accomplished mechanically, but if such a conveyor does not find a field, it must be concluded that promiscuous material cannot be successfully handled by conveying machinery.

Combined Schedule-Record-Route Sheet

By E. T. Spidy

Production Engineer, Canadian Ingersoll-Rand Company

THE accompanying form was devised to provide quick and complete information regarding any order for standard products, or otherwise, so that instead of having to go to several sources for the information the whole could be obtained from one sheet. It is a vital point now-a-days to be able to make prompt delivery of product, so we must have means of maintaining promised delivery dates. The form described will be of particular interest to firms making standard products, and not now able to ship from stock as was the case previous to wartime conditions.



OUTSTANDING ORDERS FOR 976 Ring Liners

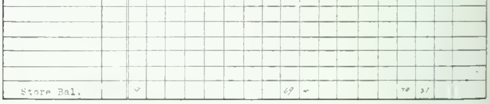
SHOP JOB LOT No	Date Issued	No Pieces	O K	S or M Order No	Date	No Pieces	S or M Order No	Date	No Pieces
975		50	7-5-17	[illegible]	[illegible]	45			
[illegible]	5	75	[illegible]	[illegible]	[illegible]	[illegible]			
				[illegible]	9-25-17	36			
				[illegible]	10-6-17	[illegible]			
				[illegible]	[illegible]	[illegible]			

SCHEDULE-RECORD-ROUTE SHEET

The questions that surround every order, those that the production department must be able to answer quickly regarding any particular part are usually:

1. How many are on order from customers?
2. How many are in process of manufacture?
3. How many are in stock?
4. When will we ship order No. . . . . ?
5. How many are required on each order?
6. When was the order placed?
7. When was order No. . . . . filled?
8. What operations are yet unfinished on order in process?
9. At what machine are they now?
10. How much time will it take to complete the whole lot without breaking up to finish a few?

All of these questions, and more, can be answered by looking up this sheet which is only 5 x 8 inches in size.



CANADIAN INGERSOLL-RAND CO. LTD 976 Ring Liners Part

PRODUCTION ROUTE SHEET #4 Machine Shop

OPERATION	Mach No
Receive	
1. Anneal	B8
2. Plane	P52
3. Grind	C114
4. Vise	V2
5. Bo.Fc.	463
6. Inspect	
Store Bal.	

Dec
1918
Time each
Schedule
Actual

REVERSE SIDE OF SHEET SHOWN ABOVE

On the "Outstanding Orders" side all order numbers are entered with the date when they were placed, and the number of pieces on each. When any order is completed it is crossed off in red ink and the date added. The first four columns are used for shop manufacturing orders, the number of pieces being as high as possible for quantity production. The balance of the columns are used to enter customers' order details. If only a part of the order is shipped, the number of pieces is changed to show the balance.

The reverse side of the sheet is headed "Production Route Sheet." The name of the part and shop locate the sheet in the index. The standard routing of operations and the machines the work is to be done on, also the allowed time per piece, are also entered.

Preventing Man and Machine Idleness

Methods that in Three Months Reduced Idleness 50 per cent. in a Large Automobile Factory

By William L. Albro

In these critical days we must conserve every ounce of energy and every minute of producing time. Both men and machine idleness must be prevented. This article gives in detail the methods adopted in the plant of the H. H. Franklin Manufacturing Company, Syracuse, New York, to gain the necessary facts to control and reduce idleness. The results are noteworthy.

Mr. William L. Albro *entered the automobile engineering school of the H. H. Franklin Mfg. Co., as machinist. He became a traveling engineer for that firm and began the study of the Taylor system of management. Later he was transferred to the production department of the Franklin Co. to install a system to prevent excessive idleness, as described in his article.*

HAVE you ever visited a large manufacturing plant and noticed the idle equipment? Have you ever noticed idle workmen and realized the amount of unproducing capital this idleness represents? Are there other machines of the same class which are over-burdened with work? Could the idle machines help to bring the over-burdened machines to schedule? Where are the operators for these idle machines? Are they producing according to their ability? Do you realize that there is a way to keep this idleness at a minimum?

Every manufacturer and production manager should ask himself these questions and find out what his answers would be if some one should ask them unexpectedly.

The amount of lost time of both men and machines in your plant, amounts to, What? Can you answer this question off-hand? Take a trip through your plant and try and estimate what this apparent insignificant phase of your plant's workings amounts to in dollars and cents.

The management of the H. H. Franklin Manufacturing Company realized what this idleness amounted to and organized through their employment department ways and means to bring it to a minimum. Their efforts have been successful and I will outline the manner of operation.

"Working without a plan is like sailing without a compass." With this maxim as our guide we planned our work as follows:

1. Survey of present conditions.
2. Report of findings.
3. Recommendation for action and plan for organization.
4. Organization.
5. Operation.
6. Report of results.

The production manager appointed a man who had training along mechanical and scientific management lines to carry out this plan; he was added to the personnel of the employment department under the supervision of the employment manager. His office was to be "Balance of labor and production clerk." He was instructed to spend at least one month and more, if necessary, on his survey of present conditions and as much time as necessary to obtain results on the balance of the plan.

1. Survey of Present Conditions.

Every deparment of the production office was studied in detail as to its management, operation and relation to other departments, with special emphasis on the control and despatch division. After mastering this, shop conditions were studied, foremen and workmen were interviewed for their opinions as to present conditions and were asked for suggestions how they could be improved.

2. Report of Findings

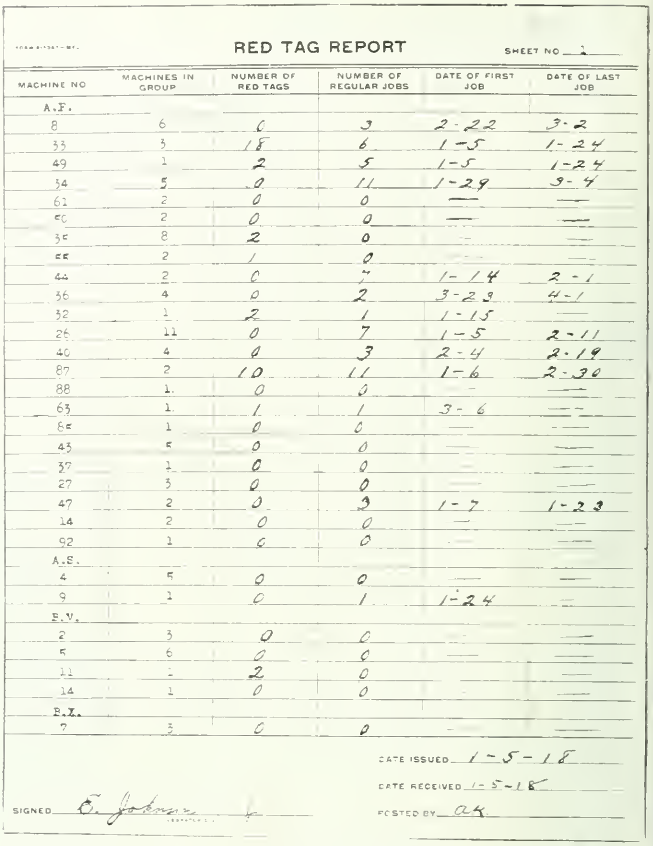
There are four main causes of idleness of both machines and men, these are again subdivided as to more definite causes as follows:

A machine would sometimes stay idle for days and then again for weeks before it would be put into operation. There was no way of checking back to see if this machine could help out some other machine of the same kind that was over-burdened with work. Machine breakdowns were not closely checked to see that the machine was placed back into operation as soon as possible. If it was for "man-cause," there were no substitutes or understudies available to keep the machine running. If it was for tool troubles, there were no means of determining the nature of the trouble, nor any standard remedy. If it was for material trouble, there were no standard remedies.

Although our plant has been operated for several years past under scientific management principles, and we felt that we had reached a relatively high standard of efficiency, still we found on careful investigation that there were several small wastes of productive time which, when considered cumulatively by the method hereinafter described, were surprising as to their amount and frequency. If a man received an idle time card he might roam about his department for a long period before he would again receive a job, and in exceptional cases he would have a tendency to roam about the factory to visit his friends. There was no standard procedure when a man went idle for placing him on work where he could produce according to his ability. The despatch department made an effort to place the man on other work but not knowing what else the man could do, these efforts were of little or no avail. I have seen skilled mechanics filing castings and burring bolts. No other thing will discourage a skilled mechanic so much as to have to do unskilled work, or have to do a boy's job. The foreman tried to place the idle men, but not knowing what jobs were urgent their efforts were of no avail.

A machine or group of machines might be chronically over-burdened or might have excessive idleness, yet this would not be noticed by the production manager or his supporters, due to the fact that there was no chart or other means of giving a graphic condition of burden or idleness, therefore, congested points would not be relieved and red tags (work behind schedule) would pile up. Idle machines would not be given a chance to relieve this congestion. The amount of work behind schedule was reported in a lump total, so no one could determine exactly what parts were held up, or on what operation, or for what cause.

There was no absolute method of proving by facts why or when new employees were needed, or for what machines they were required.



RED TAG REPORT

SHEET NO 1

MACHINE NO	MACHINES IN GROUP	NUMBER OF RED TAGS	NUMBER OF REGULAR JOBS	DATE OF FIRST JOB	DATE OF LAST JOB
A.F.					
8	6	0	3	2-22	3-2
33	3	18	6	1-5	1-24
49	1	2	5	1-5	1-24
34	5	0	11	1-29	3-4
61	2	0	0	—	—
50	2	0	0	—	—
35	8	2	0	—	—
55	2	1	0	—	—
44	2	0	7	1-14	2-1
36	4	0	2	3-23	4-1
32	1	2	1	1-15	—
26	11	0	7	1-5	2-11
40	4	0	3	2-4	2-19
87	2	10	11	1-6	2-30
88	1.	0	0	—	—
63	1.	1	1	3-6	—
85	1	0	0	—	—
43	5	0	0	—	—
37	1	0	0	—	—
27	3	0	0	—	—
47	2	0	3	1-7	1-23
14	2	0	0	—	—
92	1	0	0	—	—
A.S.					
4	5	0	0	—	—
9	1	0	1	1-24	—
B.V.					
2	3	0	0	—	—
5	6	0	0	—	—
11	1	2	0	—	—
14	1	0	0	—	—
B.X.					
7	3	0	0	—	—

DATE ISSUED 1-5-18

DATE RECEIVED 1-5-18

SIGNED E. Johnson

POSTED BY AK.

FIG. 1—MONTHLY RED TAG REPORT—8 x 11 INCHES—WORK BEHIND SCHEDULE

Recommendation for Action and Plan of Organization

It was recommended that an idle machine board be built of sufficient size to accommodate 24 sheets of graph paper (11½ x 17¼ inches), to finish both sides of this board so that the graphs of last month could be kept up for reference, and that a platform be constructed so that the poster could reach all parts of the board.

The graphs to be prepared as follows:

A. Graph sheets to be purchased, size 11½ x 17¼ inches.

B. At the top of each sheet to be placed the name of the month, sheet number, and above each square the number of each work day of the month.

C. On the left hand margin to be placed: (a) machine group name (this will be signified by symbol as —A. F., Full Automatic); (b) machine number and location symbol with leader machine in first place; (c) one line between machine groups in a single machine class to be skipped, and three lines between different machine group classes; (d) machine classes to be arranged in alphabetical order.

D. Information as to machine location and groupings to be procured from the machine and material location book which is kept up-to-date by the tool and operation department.

E. New sheets to be made every month.

F. Sheets ready to be drawn off the board to be placed in a suitable book in numerical and monthly order for future reference.

Machine Burden

A form, size 8 x 11 inches is to be printed and called the "Red Tag Report," this form to be ruled and have spaces for machine number and symbol, number of red tags, (work behind schedule) number of regular jobs, date of first job, and date of last job. (See Figure 1). Each month these reports are to be prepared by the employment department as follows: Using duplicator ribbon number each sheet from one up, place in column for machine number and symbol, the number and symbol of each leader machine in each group to be arranged as on the idle machine board. Have a sufficient number duplicated to last one month. Deliver these forms to the despatch department which will deliver to the employment department not later than 9 a. m. the following morning a complete report of the available jobs for each machine group.

Idle Machine Tickets

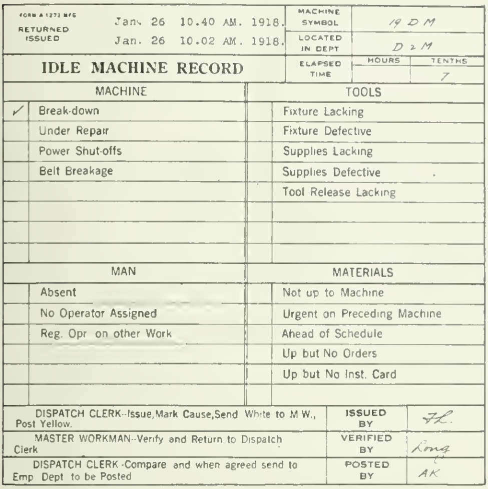
Devise a form in duplicate to include all the causes for machine idleness as mentioned in a preceding paragraph, so that it will be necessary only to check the cause for idleness that fits each individual case. Name this ticket "Idle Machine Record;" reserve space for time clock records so that the elapse of time shall be recorded; place in upper right hand corner space for machine number and symbol and elapse of time in hours and tenths; at the bottom place the procedure for each man who is directly concerned and space at the right for his signature. (See Figure 2.)

Red Tag Analysis

Devise and have printed a form that will show sheet number, leader machine number, number of machines in group, number of red tags, drawing numbers, number of parts, operation number, lot numbers, number of lots and their dates. This analysis is to be drawn from the despatch cage every week to give a synopsis of the amount of work behind schedule and the exact stage of completion, that is, where it is and how near completion. These analyses are to be given to the production manager, his assistant, the factory superintendent, chief inspector, and the chief stock chaser, as a guide where to direct their most earnest effort. A comparison summary of this report is to be made each week by giving the total of red tags charged against each department, opposite these totals the totals of two months ago, and opposite these the percentage gained or lost shown by a + or — sign. A grand total of all red tags in the factory is to be shown and its percentage gained or lost shown by the — or — sign. This summary will be a key to direct attention to the departments which are lagging behind.

Idle Man Ticket

Use the present form which is constructed similar to the idle machine record but of different color, have instructions on the reverse side as to the way to use them, why they are given, and the time limit of a single idle time ticket. (See Figures 3 and 4.)



FORM A 1273 MFG RETURNED Jan. 26 10.40 AM. 1918. ISSUED Jan. 26 10.02 AM. 1918.	MACHINE SYMBOL	19 D M	
	LOCATED IN DEPT	D 2 M	
IDLE MACHINE RECORD	ELAPSED TIME	HOURS	TENTHS 7

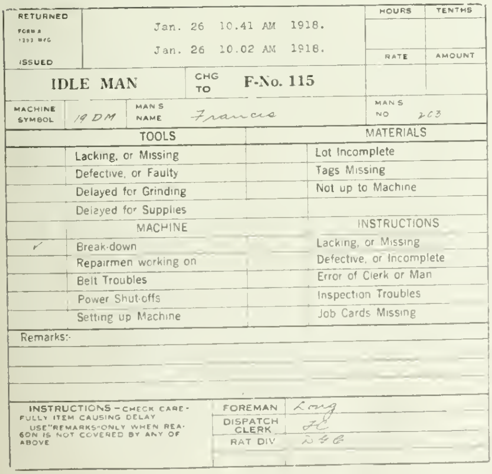
	MACHINE		TOOLS
✓	Break-down		Fixture Lacking
	Under Repair		Fixture Defective
	Power Shut-offs		Supplies Lacking
	Belt Breakage		Supplies Defective
			Tool Release Lacking
	MAN		**MATERIALS**
	Absent		Not up to Machine
	No Operator Assigned		Urgent on Preceding Machine
	Reg. Opr on other Work		Ahead of Schedule
			Up but No Orders
			Up but No Inst. Card

DISPATCH CLERK--Issue, Mark Cause, Send White to M W., Post Yellow.	ISSUED BY	FL
MASTER WORKMAN--Verify and Return to Dispatch Clerk	VERIFIED BY	Long
DISPATCH CLERK-Compare and when agreed send to Emp Dept to be Posted	POSTED BY	AK

FIG. 2—IDLE MACHINE TICKET

Idle Man Records

Construct on graph sheets as used on the idle machine board, a graph curve to show the amounts of idle time, separated to the four main reasons; tools, machine, materials, instructions. Construct separate curves for each department. The time is to be calculated by the week, a summary made and the totals added to the graphs. This will give a graphic condition of the idleness, the department it is most pronounced in and the cause.



RETURNED FORM A 1293 MFG ISSUED	Jan. 26 10.41 AM 1918. Jan. 26 10.02 AM 1918.		HOURS	TENTHS
			RATE	AMOUNT
IDLE MAN	CHG TO	**F-No. 115**		
MACHINE SYMBOL 19 DM	MAN'S NAME Francis		MAN'S NO 203	

	TOOLS		MATERIALS
	Lacking, or Missing		Lot Incomplete
	Defective, or Faulty		Tags Missing
	Delayed for Grinding		Not up to Machine
	Delayed for Supplies		
	MACHINE		**INSTRUCTIONS**
✓	Break-down		Lacking, or Missing
	Repairmen working on		Defective, or Incomplete
	Belt Troubles		Error of Clerk or Man
	Power Shut-offs		Inspection Troubles
	Setting up Machine		Job Cards Missing

Remarks:-

INSTRUCTIONS—CHECK CAREFULLY ITEM CAUSING DELAY USE "REMARKS" ONLY WHEN REASON IS NOT COVERED BY ANY OF ABOVE	FOREMAN	Long
	DISPATCH CLERK	FL
	RAT DIV	[illegible]

FIG. 3—IDLE MAN TICKET

Processes

Devise and print a questionnaire to give the employee's name, department number, address, telephone number, married or single, nationality, whether or not he is an American citizen, different languages he speaks, educational record, the number of processes he is capable of performing and an affidavit from his foreman as verification of all the facts. All processes used in this factory to be listed with a space for the length of time worked as follows:

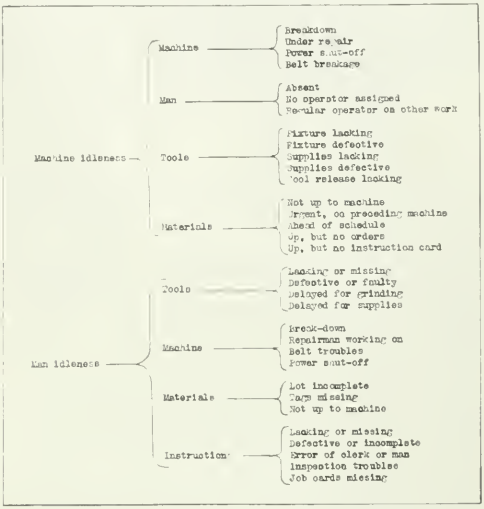


FIG. 4—CAUSES OF MAN AND MACHINE IDLENESS.

	Yr.	Mo.		Yr.	Mo.
Engine Lathe Opr.			Lo-swing Opr.		
J. & L. Opr.			Hd. Screw Opr.		

In a Rand file, cards giving man's processes are to be recorded in departmental numerical order. These processes are also to be cataloged in a separate file under processes, where all employees who can operate a J. & L. will be cataloged under head of "J. & L.," all men who can operate an engine lathe under head of "Engine Lathe," etc. If it is necessary to shift a man who becomes idle to another job we know from the Rand file where we can use him to advantage, or if we need a J. & L. operator on quick notice we can refer to our cataloged process file and find an available man. By this method we always work within our force and hire in at the bottom only semi-skilled or unskilled labor, thus reducing our skilled labor turnover to a minimum. In times of work fluxation in various departments we can shift surplus labor to or from departments with a greater degree of accuracy and discretion.

4. ORGANIZATION

The plan for organization was approved by the production manager and carried out as outlined above.

5. OPERATION

A. Construct an idle machine board as outlined above.

B. Procure idle machine tickets, having them printed in duplicate alternating white and yellow.

C. Instruct the despatch department when a machine goes idle to issue an idle machine ticket, mark cause of idleness, send white copy to master workman, post yellow in machine rack, instruct master workman

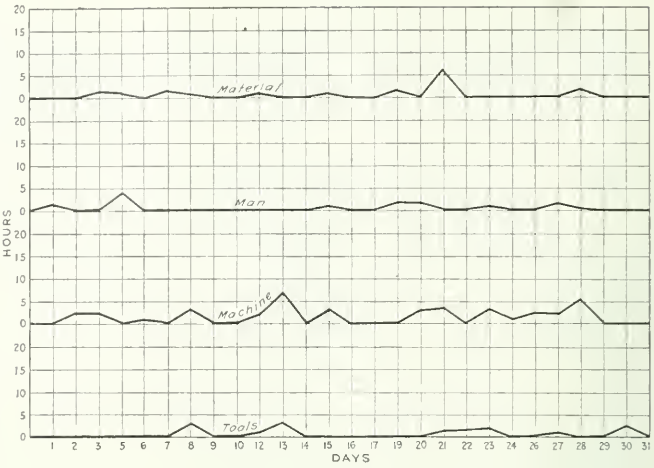


FIG. 5—CURVES FOR MONTH SHOWING WHERE MEN ARE MOST NEEDED

to verify as to machine number, cause for idleness, and return to despatch department, the latter will then send to employment department when agreed as to cause of idleness. The employment department will post this idleness on the idle machine board as follows: (a) Idleness is posted under date headings, and opposite corresponding machine numbers. (b) Idleness is shown by color as follows:

Labor,	red
Material,	black
Absence,	yellow
Tools,	blue
Machine,	green

(c) On completion of posting, the tickets are placed on file for a period of two months.

D. Construct and deliver to the despatch department the red tag report blanks as outlined above. Instruct despatch department to draw off a report each work day that will contain such information as, the number of red tags, number of regular jobs, with date of the first and last job of each machine group as outlined in the report. These reports to be delivered to the employment department not later than 9 a. m. the following morning. The idle machine board poster will record in the respective square opposite the leader machine and under the correct date, the number of red tags in the right-hand small square and in small numbers the number of regular jobs above the left-hand small square with the two dates in the left-hand small square. After posting, the report is turned over to the idle machine board supervisor who makes the necessary notes, then it is to be filed for a period of two months.

E. When necessary report to the production manager all doubtful cases so that corrective action can be taken.

F. Idle man tickets are to be handled as outlined for idle machine tickets, and delivered to the employment department not later than 9 a. m. the following day. The time limit of an idle man ticket is one hour and if at the end of that time the man is idle, the despatch department will send the man to the employment department, which will consult the process file, and send him to a department where the need for men permits and where he will produce according to his ability. The despatch department will be notified by a temporary transfer where the man is to be sent, and when production conditions require the man's return the despatch department will notify his temporary foreman who will send him back to his regular department. Idle man records are to be maintained as outlined in a preceding paragraph. Reports are to be made to the production manager if there are any doubtful cases, or if any department has an exorbitant amount of idle man-time charged up to it.

G. When it becomes necessary to change the sheets on the idle machine board the old sheets are to be placed in a suitable book with regard to months and sheet numbers.

6. REPORT OF RESULTS

The first three months that this system was in operation the idleness decreased 50 per cent. and has been steadily decreasing every month. An absolute check on red tags (work behind schedule) is made possible. Red tags are kept to a minimum as it is easy to plan a re-routing of the flow of work to the machines which are idle for lack of work or are not heavily burdened. It gives the production manager a graphic condition of the entire factory at all times. It shows the employment department where the need for men is the greatest. See Figure 5 plotted for a typical month.

To show a graphic condition of the work behind schedule in the entire factory we compiled all the data we collected on red tags, and plotted curves by departments using a different color for each department. These curves were available at all times to all persons who were concerned in reducing factory burden, and they acted as a guide where to concentrate the most earnest efforts. The main object was to keep the lines on a downward trend and to keep peaks off the chart.

From time to time the idle machine charts were laid out according to months and to machine groups, to give the condition of each individual group or class groups for a period of six months or more. Then an analysis was drawn off which included all the factors as shown. This shows the production manager where the need for extra equipment exists, where excessive equipment is located, where the flow of work is uneven, the prevailing cause of idleness on certain machines or machine groups, the need of new equipment to replace old where the machine is constantly going idle for repairs, and a number of little details which were of great assistance to the production manager and his staff.

The production manager, his assistant, the tool and operation department heads, foremen, and even workmen consult the idle machine chart daily for this, that, or the other reason, proving that it is of utmost importance to have an up-to-date method of idleness and burden control that will at all times give the exact conditions as they exist in the shop, whether or not these conditions are improving and where the source of the trouble is.

At this critical time it behooves us to conserve every ounce of energy and every minute of producing time. This plan if carried out faithfully will be a great factor in industrial efficiency.

Hunting for a Factory Location

Five Tests to Apply in Selecting an Industrial Site

By L. W. Schmidt

The immediate future will undoubtedly see the locating and relocating of many industrial plants. The author explains the principles behind five special tests that should be applied in making a selection, and from his own practice shows how these are made.

Mr. L. W. Schmidt *is an economist with international experience. For more than ten years he was in charge of a bureau in London, England, to assist manufacturers in the development of foreign commerce. He has written extensively on economic questions affecting American industry, and is in charge of the Research Department of the New York Economic Service Bureau.*

IMPORTANT manufacturing centres are not the result of coincidence but of well defined economic evolution. It may be a coincidence that one particular factory should be founded by an enterprising man in a given locality, but its continuous prosperity is only possible if the conditions of that locality favor the existence of such an establishment. There are plenty of examples in this country where a daring pioneer has planted an industry where it formerly had not been. Others followed in his footsteps and influential manufacturing centres have grown up. We have, however, just as many examples where the pioneer and his followers were wiped out by one of the economic depressions formerly so frequent in this country. The question arises: Was the continued prosperity of the first or the ill luck of the second to be foreseen by a close study of local conditions? Are there any rules to establish the suitability or unsuitability of any given locality for any given industry? Without doubt, an answer to this question is just now of great interest to many manufacturers in this country.

In selecting a factory site five special tests should be carefully applied. These concern:

1. Accessibility, both national and local.
2. Proximity to sources of raw material and markets for the product.
3. Supply of labor and scale of wages.
4. Supply of power.
5. Rents and taxes.

The manufacturing districts of our big industrial cities are in most cases not the outcome of a premeditated scheme, on the contrary, most of them, at least those of older date, have grown out of and with the general growth of the surrounding communities. So residential and retail sections are frequently intermingled with purely manufacturing districts. Recently, the professional community planner and real estate agent have taken a hand in the building of our industrial cities, and the result has been a better layout. Generally speaking this has made for greater accessibility of the manufacturing sections, and the manufacturer looking for a factory site in one of these newer localities finds as a rule little difficulty in locating. In the older cities, however, greater care must be taken.

Lack of Care in Selection

During the ten years preceding the beginning of the European War the United States had to accommodate approximately 60,000 new factories with a corresponding increase in labor of 1,500,000 persons. In providing for buildings for the new factories little care seems to have been taken as to the special suitability of their location, with the result that there are today hundreds of factory buildings standing unused for no other reason than that they have outlived their utility. Many of these buildings have been given up because they proved inaccessible. Local traffic, railroad communication, main streets, were favoring other localities and made them more desirable as factory sites.

Accessibility of a factory site may affect the plant erected thereon both from a national and a purely local aspect. With the present railroad system at the disposal of manufacturers there are few cities which might be called inaccessible from a national point of view. Every distributor of merchandise, however, knows that there are certain grades of accessibility. It will frequently take less time to ship a package to a city far away than to another nearby, if the first should happen to be an important railroad centre.

The deduction is that it will be of advantage to be located near a railway centre.

As to local accessibility preference should also be given to the site in easy reach of a terminal which, if it does nothing else, will reduce the time spent in trucking between the terminal and the factory. As regards accessibility there is doubtless an advantage in numbers. Truckmen will visit more frequently districts where factories abound, railroads will be more ready to extend sidings in the direction of a cluster of factories, while the single manufacturer, be he not a very important customer of the railroad, will find scant consideration. Tramways will be attracted by the nickels of the workmen. It pays, therefore, to be located in one of the important manufacturing sections unless, of course, there are important reasons why this should not be done.

A Preliminary Survey

How the local conditions lie with each individual, prospective site is a matter which has to be decided on the spot. Only a personal inspection will give complete satisfaction. As a preliminary test the following is recommended. Take a railroad map, locate your prospective neighborhood and see how many railroad lines serve it. Find out how many express and local trains enter and leave daily and get a line on the approximate number of freight trains running on schedule. Finally, see how many mail deliveries there are daily. If accessibility from any given point is of importance, see how the railroad and mail service operate in respect to this point. Study locally the number of nearest approache of railroad sidings, tramway lines, and main thoroughfares to your intended property.

The second question to be taken up is that of supply of raw materials and the advantages offered by the location as to the distribution of the manufactured article. The present disorganization of the country's railroad service has taught us the lesson that things are not at all permanent. Even the best system of supply may break down and manufacturers who have relied on the railroads for their raw material have suddenly been without much needed shipments. Doubtless it has been a great advantage to a factory to be located near its raw material sources. The lesson, once learned, it is hoped will not be soon forgotten. In future more care will be taken of this important factor in the location of industrial plants.

Sources of Raw Material

The tendency of placing industrial enterprises in easy reach of their sources of raw materials is, of course, not new to the economist of this country. By a process of natural selection factories have grown up where economic conditions were favorable to them. Therefore, we find the iron industry of this country concentrated around the coal deposits of Pennsylvania, and accessible to the iron of the Lake region. We find that industries buying manufactured iron are located in the same districts, or places where cheap and plentiful transportation seems to guarantee a regular and low priced supply.

With all experience in favor of near proximity to the raw material there is not much doubt which of two factory sites will be selected on this account. Difficulties, however, arise in the case of factories requiring for their production a number of different raw materials having widely separated sources, and further of industries drawing their raw materials in a partly manufactured state from other factories. These, in fact, are the majority of all industrial enterprises. The decision may be given in favor of proximity to that material which is largest in bulk.

In looking over the different prospects it will be found most likely, that there are localities where the demand has already attracted the supply, where the existence of bulky raw materials has attracted those industries which serve to supplement those that consume the principal raw material. This location is preferable to any one offering only the one or the other advantage. If both cannot be had, or if reasons exist why another locality should be preferred, the problem will have to be worked out with a map and a city directory. The one agency will give the information needed as to the best means of drawing raw materials from their sources, the other will help to determine the existence and number of supplementary industries which can be relied upon for secondary supplies.

Accessibility to Markets

No locality, however favorably it may be placed as to the supply of raw materials, will give satisfaction unless it gives also easy access to the expected markets.

The question whether a factory should be located in its market, has never been fully settled to the satisfaction of our distribution experts. If proximity to the market would be a deciding factor by itself, we should have to locate many of our big enterprises quite differently from where they are now to be found, and probably less advantageously. There are, of course, industrial enterprises which are by their whole character more or less dependent upon a local market and which would suffer severely when cut off from it. The fact, however, seems to be that the great majority of our big industrial enterprises might be moved quite easily to other locations with no detrimental effects on their sales. Proximity to the field of sales, therefore, must be held as of secondary importance to the prosperity of the majority of industrial enterprises, provided general accessibility and proximity to the raw material sources are satisfactory.

Lately, several cases have come to the writer's knowledge, where manufacturers have moved their plants so as to be nearer to their principal sales field. Most of these instances seem to refer to supplementary industries in the case of which proximity to the principal buying industry may be of importance. Such movements have taken place as the result of increased industrial activity in certain neighborhoods. The last three years have been especially instructive in this respect. It may also happen that a principal industry, having grown up in an unproductive soil, slowly fizzles out or seeks other fields, in which case the supplementary industries will have to follow. Of course, the selection of the new locality will have to be made largely under the aspect of associating the new plant with a prosperous or at least prospective market. The factor proximity to market gains in importance, and may finally turn the scale in favor of one or the other locality.

Character of the Sales Field

A study of local conditions should include also an inquiry into the approximate character of the sales-field of the firms that may become customers, the number of men employed by these firms and their turnover. If competing firms are in the field it is essential to know whether the market has any material chance of expansion.

As to general distribution facilities and proximity to the markets, the test advised in respect to determining national accessibility will give an answer.

Labor Markets and Labor Supply

Most changes of factory locations during recent years have resulted from the desire of the manufacturer to recondition his labor situation. With present day conditions in the United States labor markets the chances are that he will be just as badly off in his new location as in his old. Great care, therefore, must be exercised in establishing a factor in favor or against a locality on the count of labor supply.

In normal times it is fairly easy to get a line on the likely supply of labor in any given locality by simply consulting the census reports of the industry in which the inquiring manufacturer is interested. Take, for instance, the electrical machinery industry. According to the Census of 1914 there were employed in that industry 118,078 hands. Of these 23,000 were employed in the State of New York, 17,000 in Massachusetts, 16,000 in Illinois, 14,000 each in Pennsylvania and New Jersey, and 12,000 in Ohio. The deduction is that in any one of these states there can be found labor sufficiently trained to be employed in factories making electrical machinery. This situation has not arisen accidentally, it is the outcome of an economic development of several years standing. By comparing the Census figures of 1914 with those of 1909 it is shown that already then the State of New York had taken the leading position as an employer of labor of this character. The second place was taken by Massachusetts; Pennsylvania and New Jersey were competing closely for third place; Illinois, which in 1914 stood third, ranged in 1909 behind the two states just named, while Ohio remained sixth.

Labor is not always drawn to a new enterprise from already existing plants. The manufacturer bringing his enterprise from another district may find in the new location a certain quantity of floating labor trained in the work he wants to have performed, but this labor in the best case can only be a small percentage of the total available. Most likely he will bring with him a certain number of the hands he has employed in the old plant, and will augment that force by hands he finds available. For the rest he must necessarily rely on the surplus of labor coming from other industries.

SUPPLY OF TRAINED EMPLOYEES

It is only natural that some guesswork must enter in determining the possible number of trained but unemployed hands to be found, and there is still more guessing as to that available from other sources, probably from industries allied to that of the manufacturer contemplating the change. Also the Census may give some valuable hints. That part dealing with individual industries contains valuable statistics showing the maximum and minimum of labor employed in each industry during one year. It appears from these figures that in the State of New York, for instance, there was during 1914 a difference of 16.3 per cent. between the highest and lowest number of men employed in the electrical machinery industry. In Massachusetts the percentage difference during the same year was 18.9 per cent., in Illinois 22.9 per cent., in New Jersey 19.7 per cent., in Pennsylvania 10.8 per cent., and in Ohio 14 per cent. It is not always a sure guess that all, or the greater number of these men will be really available for a new factory, as men when unemployed frequently leave the locality and go to another where they hope to find work. But there is no doubt that a city offering a good surplus of the number of men employed at the highest point of activity against the lowest comparative point of a normal year, will give a better chance to fill the labor roll than one where there is little fluctuating supply.

During the past few years there have been frequent examples of large manufacturing plants changing locations to places offering apparently better labor conditions. There is an instance of a big factory in the garment trade that had to turn to woman labor. After a careful study a large city in the South was found which seemed to have a surplus of woman labor that could be trained for the work required. In this case the labor was recruited principally from allied industries that were suffering from a business depression.

Of some interest in this respect is the attraction which Connecticut seems to have had for the machinery industry of this country during the last three years. The reason for this is not difficult to find. Connecticut is the leading State of the Union as a producer of brass, bronze and copper products; it also takes the leading place in manufacture of cutlery and edge tools, in making of fire arms, and in production of pins and needles. In addition to this it has powerful industrial neighbors as New York, New Jersey and Massachusetts, states which always can be relied on to have a large stock of floating labor connected with the metal industries. The enormous capacity of the city of New York alone forms an immense reservoir of labor to be drawn upon It is obvious that such a state as Connecticut should offer man advantages for industrial expansion

The example of Connecticut, however, does not stand alone. It is repeated by many other states of the Union. In fact, a close study of conditions will show that each of the states offers certain peculiar characteristics.

THE POWER SUPPLY

Next in position to the availability of labor and owing to the dependence upon coal, power as a factor in selection stands closely related to general accessibility.

In this respect the manufacturer looking for a suitable location for his plant must be guided by the consideration whether he intends to generate or buy power from a central station. How important a part in the first instance is played by a near and secure supply of coal has been brought home to us during the past few months. While, of course, no manufacturer has any special benefit under a general closing order, there is no doubt that during a time of stress in the coal supply the manufacturer in easy reach of fuel has a material advantage over his competitors, especially if both are large users of steam power. There may be noticed an increased concentration of the so-called heavy industries in proximity to coal fields, or in localities where general transportation conditions promise a regular supply.

The application of electric power bought from a central station has modified somewhat the importance of a secure coal supply in the selection of factory sites. As far as this side of the question is concerned much must be left to individual taste and general policy. Of course, conditions change in every industry, and not all are consumers of an even quantity of electric power. As a guidance to those interested in this complicated question the following statement is offered showing the relative needs of individual industries as to the consumption of power during the year 1914, expressed in horsepower units:

	Total Power	Electric Power Used	Electric Power Rented
Agricultural machinery	121,428	83,117	30,764
Boots and shoes	112,920	61,657	37,389
Canning	120,092	28,438	18,726
Cement	490,402	336,516	164,309
Chemicals	282,385	172,510	134,481
Cotton goods	1,585,953	512,903	252,864
Electrical machinery	227,732	262,119	74,476
Foundries and machine shops	129,768	806,840	444,328
Iron and steel works	2,706,553	1,207,715	182,204
Rubber goods	151,927	93,998	25,664
Shipbuilding	115,333	66,275	30,085
Dye stuffs	23,290	2,750	745

THE ITEM OF RENT

Districts offering great inducements as to accessibility, labor conditions and power supply, have frequently the disadvantage of being expensive. Factory property may be high and tax rates set accordingly. Many an industrial enterprise has come to grief because of excessive overhead expenses. High rents have frequently been the cause of disaster. There is always the danger that more is bitten off than can be chewed conveniently. The safest way to go about it is certainly to figure out beforehand what amount can be spent on rent and to vary this sum only when there are causes which will affect favorably the overhead expenses in another direction. Exceptional accessibility for instance may reduce the cost of raw materials to such an extent as to justify an increase in cost for factory rent or in the price of the site if bought outright; so may a saving in power. Care should be taken that only expenses recurring annually are set off against the rent or interest for money invested in buying the site.

A frequent experience in this direction is that sites bought cheaply originally, are suddenly made expensive by an increase in local tax rates owing to improvements somewhere else. This is a difficulty which cannot be avoided entirely. It is met with less frequently in localities where the development is completed or near completion.

How the Rules Are Employed

After having discussed in this way the principal factors which should govern a manufacturer in selecting a site for his enterprise it now remains to show how the rules laid down can be employed. The process of selection is largely one of elimination followed by valuation.

The first step is to eliminate all those districts where, for some reason, the plant cannot be erected. By doing this the field of selection will be restricted gradually to a number of districts which seem promising. Of these districts a selection will have to be made on a test of accessibility. The writer has found it a good plan to make a special inquiry for each locality. For the result of each test a figure is given in the same way as is done on examination papers.

As a concrete example an actual research made by the author is given. In this case a location had to be found for a new plant for a factory making a chemical specialty. The firm had been in existence several years and wished to expand. Removal to new quarters became essential owing to lack of space. In this case we made a scale of merits beginning with 10 points for "excellent" ranging down to 1 point. To the points to be given for accessibility, supply of labor, etc., 10 points were added for general utility and 10 for the final result of local inspection. Owing to the character of the product of that firm practically only cities with a port could be taken into consideration. Therefore, after about 26 localities had been considered, the search finally narrowed down to three properties. Two of these were located in a port which may be called A, the other in B.

As to national accessibility both ports were situated evenly. Property 1A was located up a river a quarter of a mile inland, but in easy reach of a barge landing. Property 2A was practically in proximity of the river. The property in B was immediately on the river. The factory was to make a material used as a basic material in one of the biggest industries of this country. Most of the factories using the material in question were located in the East and it appeared that there was not much difference in respect to proximity to the markets in both cases. Going more closely into the matter we found that there was in favor of A the fact that part of the market in question might be reached by waterway which one day might be a decided advantage. This possibiliy we pointed out to our client, but no points were given for it. As to the proximity of raw materials we were confronted by the peculiar situation that part was of American origin and part imported. The American sources certainly were in neither case in proximity to A or B. On the other hand it was quite out of the question to locate the factory in proximity to the American raw material sources, as the principal part was imported from Central America, the West Indies, South America and Africa. Doubtless a port which had a regular connection with these foreign sources would be preferable to any other. In this respect A easily beat B.

Nearly all of the labor force would have to be transferred from the old factory. This was a point in favor of A, but we were told not to take this into consideration if a good location could be found elsewhere, as the management was willing to go to a fairly high expense in transferring its highly skilled help. As to supplementary labor conditions in both cities were fairly even, with a slight balance in favor of A. Living conditions being slightly higher in A than in B it appeared that the A properties most likely would have to be penalized in points against B in respect to wages. The supply of power was even and excellent. Rents, building cost, and therefore interest on initial expenses appeared higher in A. We had, therefore, the following result of the preliminary inquiry:

	1A	2A	B
Accessibility, national	10	10	10
Accessibility, local	8	9	10
Proximity to raw materials	10	10	7
Proximity to markets	10	10	10
Supply of labor	10	10	9
Wages	9	9	10
Supply of power	10	10	10
Rent, building, etc.	9	9	10
	—	—	—
Out of possible 80	76	77	76

The final decision went to port A. The selection then lay between properties 1 and 2. The local inspection in both cases bore out the preliminary tests and we, therefore, added 10 to each. In going into the question of general utility we found, however, one point very much in favor of location 2A. This property was placed in such a way that by buying an additional property it could be connected immediately with the river so that barges could be conducted directly to the factory. This gave 2A an additional 10 points for general utility which settled the question in favor of that project. In viewing this example it should be kept in mind that this is the final selection, and that properties examined in the earlier stages of the test showed considerably larger variations in grading than the three reviewed.

Much of the work was done without moving from our desks. As already shown, a good map, an encyclopedia, the United States Census reports, and other literature readily supplied by our government, will help to compile the necessary facts. Where more information is needed, a letter to Washington will bring it. The manufacturer will also get valuable help from local town councils and chambers of commerce. These two agencies are always most obliging and will give ready answers to inquirers.

So extensive is the field of possible activity for Engineering Council that even yet it is unwise to set its bounds. Nevertheless, some of the proposed activities may now be outlined. Foremost among these is the fostering of a sense of solidarity throughout all divisions of the profession in all parts of the country,—the increasing of a sense of common interest and of the strength that results from unification. To this end, subordination to the general welfare of the preferences and pride of organizations and of persons may be necessary; but it is confidently expected that even through difficult places the right paths will be found. Patience and good sense will win full and effective coöperation. Publicity of a high order, but of a practical sort, must be devised that both engineers and the public may be informed not only of engineering achievements in physical work, but also of the services which peculiarly pertain to engineers, in mental realms, those which they are performing and those which they should perform. Engineers and engineering must be made more comprehensible to the people up and down the land, and kept instructively and interestingly in the public prints. A most important service is the standardization of definitions, methods, requirements and tests for all varieties of engineering materials and work. Others are the improvement of the methods used. On methods of classifying and indexing the committee has already done not a little work. It is the intention to discover what has been done by others and so as to combine and strengthen all useful systems as to secure the greatest benefits.

The Employees' Benefit Association--V

How Shall Dues Be Handled? What Dues are Needed for Safety?

By W. L. Chandler

The matter of dues is of the utmost importance in any employees' benefit association. If they are too high members will be hard to obtain; if they are too low assessments must be made and these bring ill feeling. The wise policy is to have the dues produce enough income so that there shall be a slight surplus at the end of each year to be distributed to the members. In this article is given a series of carefully computed tables for flat rates for dues on a weekly basis, covering the disability of a member for various periods, and death.

The research which made possible this series of articles was carried on by Mr. W. L. Chandler *during a period of three years as a spare time contribution to the Employees' Benefit Association of the Dodge Manufacturing Company, which had been in operation for 25 years and it was presented to them on their silver anniversary for consideration along with a suggestion for a new set of by-laws.*

LABOR turnover is one of the nightmares of the employer today. Benefit associations may be made to serve an extremely important part in reducing this turnover. Statistics covering 342,000 members show that the turnover of these members was 33 per cent. What a happy contrast to the figures of some establishments, where turnover reaches 400 and sometimes 600 per cent.

It is ridiculous to assume that this low turnover is due entirely to the existence of the employees' benefit association. However, it is safe to assume that where such an association exists, and has the enthusiastic support of the employer, other equally effective forces are also utilized to increase the adhesiveness of employees.

In previous issues of INDUSTRIAL MANAGEMENT we have surveyed the association from several angles, and have considered the various amounts of benefits to be paid to members when they are sick or injured. Next, we must compute the amount of dues which must be paid into the treasury to make it possible to pay those benefits. Fees and dues therefore are the subjects of this installment.

PROBLEM NUMBER 58

SHOULD AN ASSOCIATION HAVE AN ENTRANCE FEE?

Entrance fees are exacted by 80 per cent. of the associations managed by employees and by 40 per cent. of those under joint management, while only one under establishment rule requires an entrance fee.

These associations have fees varying greatly in amount. Seventy-nine per cent. have one fee without regard to class of membership, ranging from 5 cents to $10, with $1 predominating and 50 cents taking second rank. One association, basing dues upon a percentage of the wage, has an entrance fee equal to one day's pay; another, making use of a dividend plan, requires a new member to pay in his pro-rata of the amount in the treasury; while another having "shares" charges the value of a share at time of enrollment. Of the associations having entrance fees, 21 per cent. graduate them according to classes of membership. One association has 13 classes, while others have from two to nine classes, two being the prevailing number, with three coming second. Of the associations having graduated fees, 45 per cent. base them upon wage; 39 per cent. base them upon age, with the remaining 16 per cent. using various other methods. In one-half of the associations the highest entrance fee does not exceed $1.25, while the average of all associations having an entrance fee is $1.13 for the highest class. Sixty-two cents is an average of second-class fees for those having them, and those with third-class members have the average of 62 cents for third-class.

Some associations have a smaller fee for a limited time after employment begins, as an inducement for prompt action. See Dodge By-laws Article VIII.

Section 1. The dues of the Association shall be payable every other week, or semi-monthly pro rata on pay days, by being deducted from wages by the Paymasters of the Company acting as attorneys for the members.

Section 2. In lieu of a membership fee, the dues of each member for the first fourteen weeks after joining shall be forty cents in addition to the regular dues.

A few associations require all members to take out a new membership each year and pay an entrance fee each time. These usually are those dividing among the members the balance in the treasury at the close of each year.

Several associations using entrance fees graduated according to age, start with, say $1 for all ages up to 45 years and $1 extra for each year after that. The fee for 55 years on this plan would be $11, which is probably meant to discourage old men from joining.

An employee who reaches old age after he has been a member for several years, has contributed toward the relief of others during his younger days and is thus entitled to see the bread on the waters come back to him. An employee who reaches old age and has not been provident enough to contribute when young, when he finally decides to join, is not entitled to the same consideration as the other man. However, it is both unwise and unjust to demand a big entrance fee which, by keeping him outside, deprives both him and the association of the benefits of his membership.

The initiation fee is paid only once, and it is not possible to adjust equitably the difference in cost of insurance covering a long period in such an initial payment. Dues are paid continually and the insurance is carried similarly. The running cost of the protection accorded can better be paid by the running dues rather than by an initial payment.

Employees cannot expect to wait until they reach old age with its greater risks of sickness, accident and death and then join the association at a rate of dues which is not sufficient to pay their proportion of the losses.

It is, however, a source of inconvenience to make distinctions in the dues each week, but it is not so difficult to graduate the benefits when disability or death overtakes some member who reached some specified age before joining the association. (See by-laws of Dodge Mutual Relief Association, Article VIII, Sections 8 and 9.)

Sec. 8. Members who join the Association after they are 45 years old, shall receive benefits as follows.

Age at time of joining	Benefits will be
46 to 50	10% less than regular schedules
51 to 55	20% " " " "
56 to 60	30% " " " "

Sec. [illegible]. Nothing in Section 8 of this Article shall affect the benefits due under any membership taken before member reached the age of 46 years and kept continuously in force thereafter.

PROBLEM NUMBER 59
SHOULD AN ASSOCIATION HAVE A FEE FOR THE REINSTATEMENT OF MEMBERS WHOSE MEMBERSHIP HAS BEEN INTERRUPTED?

There are three causes of interruption to consider:

(a) by suspension or expulsion.

(b) by the member leaving the establishment,

(c) through other causes.

Forty-six per cent. of all the associations make no mention of any provision to collect fees, fines, arrears or anything like a penalty for reinstatement; 26 per cent. have specified reinstatement fees, without any other stated penalties; 8 per cent. have a specified fee and also exact all arrears; 17 per cent. have no regular fee, but exact all arrears, fines, etc. The remaining 3 per cent. are scattering; two distinguishing between those leaving the establishments and those dropped, the others having slight distinction according to circumstances surrounding the reinstatement.

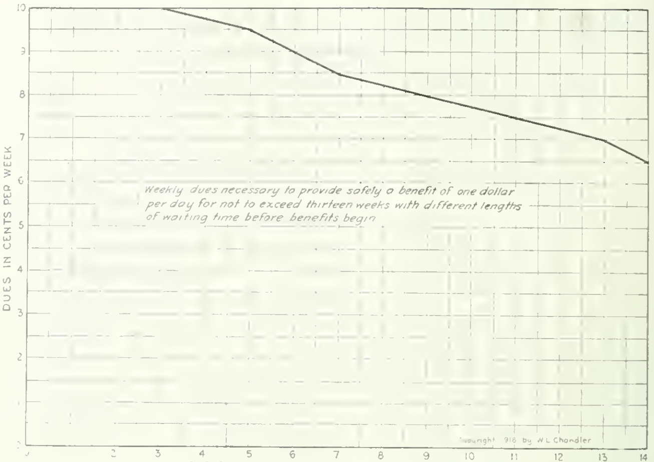


CHART 16

The average fee is $1.10, the largest being $10, except one association with a fee of $25 for members who withdrew after receiving 12 weeks' benefits. (I imagine this would freeze out a great many.) Only three exceed $3, while one has a fee of five cents. (See by-laws of the Dodge Mutual Relief Association, Article VIII, Sections 5, 6, 7 and 18.)

Sec. 5. When no wages are due a member from the Company, dues must be paid when due, without solicitation from the Secretary in order to retain membership, except that in event of a member otherwise eligible for membership being temporarily laid off by the Company, the Directors, upon request and satisfactory assurance of credit responsibility, may arrange to extend the membership for a period not to exceed thirteen weeks, when the amount in the treasury will warrant it, and on condition that all such accrued dues are to be deducted from any benefits paid until the accrued dues are paid up.

Sec. 6. When members have been laid off temporarily, and then resume work after having had the advantages of protection as covered in Section 5, whether receiving benefits or not, their dues shall be doubled until all indebtedness to the Association has been paid.

Sec. 7. The provisions of Sections 5 and 6 are available only to members who continue to reside in the same county, and do not take up any occupation, which, in the opinion of the Directors, should enable them to pay their dues, or should warrant the Association in cancelling the membership.

Sec. 18. A member having been reinstated after suspension or expulsion, cannot participate in benefits until three months after reinstatement, except by consent of Directors.

PROBLEM NUMBER 60
SHOULD REVENUE BE COLLECTED BY DUES OR ASSESSMENTS?

A woman with a shawl over her head stood watching a grocery clerk filling her order for sugar. He had filled the paper bag at the sugar bin and now had it on the scales where it proved to contain more than she had ordered. He stood with the scoop poised in the air above the bag and made successive dips into the contents in his efforts to reduce the weight enough to get a balance. Each dip of the scoop sent a chill down the back of the woman as she saw the amount of sugar grow less. Regardless of what the scales showed, that woman felt that bag of sugar to be the smallest and stingiest she had ever bought.

Suppose the clerk had purposely brought the sack to the scales with too little sugar in it and had gone back for another scoop full to balance the scales, the impres-

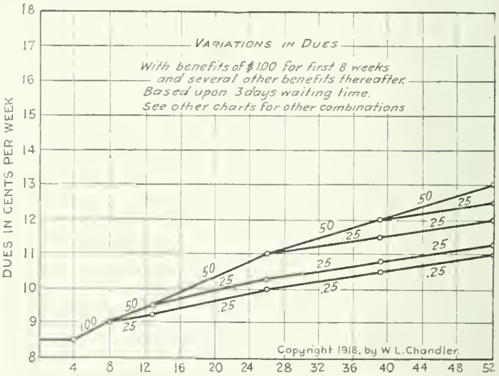


CHART 17

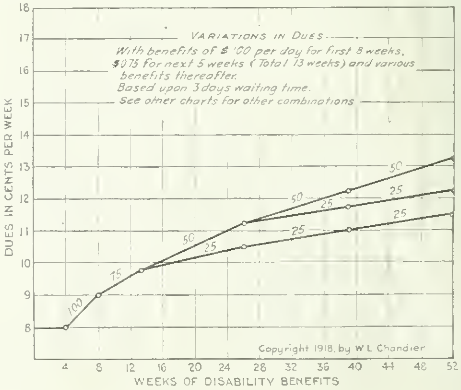


CHART 18

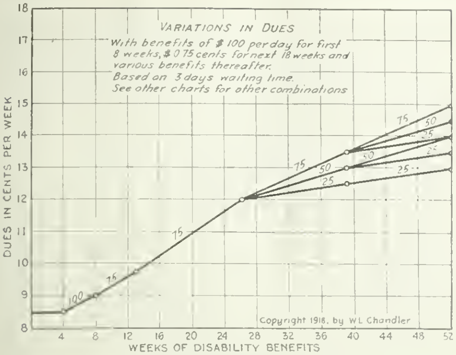


CHART 19

sion on the woman's mind would have been much more pleasant even though the amount of sugar was the same in both cases.

Similarly, while every association should have the authority to levy an assessment when epidemic or other calamity occurs, there is woe ahead for the association that finds it necessary to use that privilege more than once in a lifetime. To the members, it will surely seem that assessments are coming all the time, just as the clerk seemed to be dipping out most of the sugar.

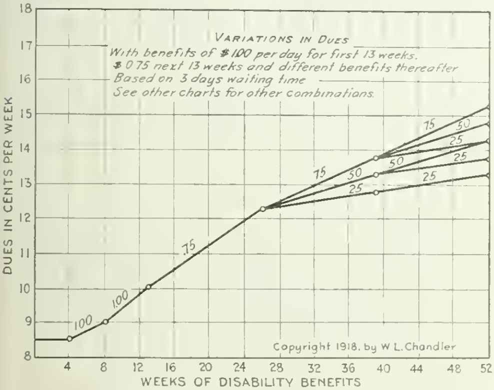


CHART 20

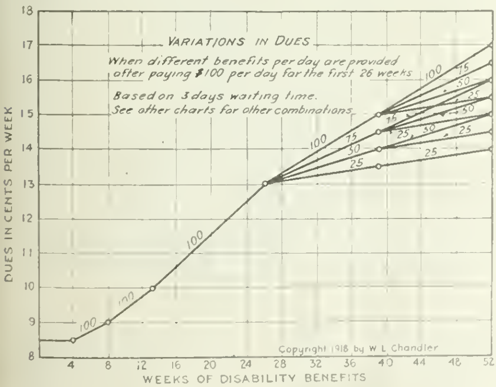


CHART 21

Dues should be made high enough to begin with so that dividends may be declared once or twice a year. It is impossible to anticipate exactly what the dues should be, but the members will never object to a dividend, and, in fact, experience shows that great confidence and enthusiasm follows a declaration of dividends.

As an illustration, the Dodge Mutual Relief Association, less than a year after the present by-laws and dues were adopted returned two weeks' dues in cash to each member, stating that the association was prospering and did not need the money. It was also pointed out that getting in new members helped the association and conferred a favor upon the new members.

During the following six months, the initiation fees from new members admitted more than made up for the dividend declared.

It is not possible to measure all the good accomplished by this dividend, but every member had increased confidence in the soundness of the association and was boosting it along. Enthusiasm felt for anything about a plant must of necessity be associated in the minds of the employees with the plant itself, so the indirect benefit to the employer was worth consideration, and the enlarged membership benefits both association and employer.

Ninety-three per cent. of the associations have regular dues, two-thirds have assessments, several have both plans of collecting revenues. The plans differ in that some make the dues low and use assessments at intervals to make up the deficit when needed; others make the dues sufficient so that dividends may be declared or dues remitted when conditions are favorable; while some restrict the benefits to conform to the capacity of the treasury supplied by the receipts from dues without assessments. Six per cent. of the associations use assessments only, while one establishment (association under joint management) set aside an amount of stock to provide income without either dues or assessments.

Of the associations under the management of the establishments, 86 per cent. have dues only; one concern maintains the association without contributions from members, and the balance, 14 per cent. have assessments only.

Assessments are divided into "ordinary" and "extraordinary," according to their use. Thirty-three per cent. of the associations have dues and no assessments, while 36 per cent. have dues with extraordinary assessments only when in extreme need of money, making really 69 per cent. of the associations endeavoring to avoid assessments as far as possible.

Of the associations which try to avoid assessments, 67 per cent. operate successfully without contributions from the establishments. Of the associations regularly making use of assessments, with or without dues, 78 per cent. are operating without contributions from the establishments.

Of all the associations, 31 per cent. use assessments regularly, either to maintain a specified amount in the treasury, or to take care of death or other specified claims as they arise, there being a wide distinction between this type of assessment and the ones used only under extraordinary circumstances.

The psychological effect upon the members or prospects of collecting dues large enough to permit dividends or remit dues, as against making assessments of uncertain frequency or amount, should be carefully considered. The cost of doing business and, therefore, the net amount actually paid by members will not vary in either case, so one should adopt the plan offering the greatest psychological advantage.

Enthusiastic old members are needed to induce new employees to join. Assessments when used regularly seem to the members to be called more often than they really are, but if the regular dues will provide a little more money than is actually required during the year, and thus skipping dues at some period, say Christmas time, enthusiasm will be boundless and new members will be easier to get.

Problem Number 61

What Amount of Dues Should Be Collected?

This problem may be split into seven parts:

(a) for temporary disability.
(b) for permanent disability.
(c) for dismemberment.
(d) for death of member.
(e) for death of wife.
(f) for death of child.
(g) for social benefits.

In determining the amount of dues to be collected, several important things must be borne in mind:

1. Dues must be sufficient to prevent necessity for assessments.

2. To the average men, weekly dues being smaller seem more reasonable than monthly dues at the same rate.

3. Benefits computed by the day are easiest to handle.

4. One dollar per day is the general favorite of disability benefits.

5. In many localities ten cents per week is quite popular as dues.

6. Psychology plays an important part in the securing of members.

7. If you adopt rates given herein suitable for a live organization, you must make it a point to have a live organization or you may not be successful.

8. The live association is one with at least 70 per cent. of the employees as members.

9. Stock companies commonly write health and acdent policies for dues of $1 per month paying disability benefits of $1 per day. This fact indicates the popularity of these rates and benefits.

There are two methods of handling the dues and benefits of an association. One plan is to charge a flat rate of dues for all members. Here a combination of benefits may be made and rates may be figured accordingly. In the attached tables of flat rates, all figures are based upon weekly dues, which may be collected every other week or otherwise as desired.

Temporary Disability

Very much depends upon the amount of waiting time before benefits begin and the duration of benefits before they cease.

In a charting of cases of disability, 100 per cent. includes only cases between 4 days and 13 weeks inclusive. By requiring 4 days' waiting time instead of 3, we would eliminate the cases of 4 days' duration which comprise 12 per cent. of the total number.

Ten per cent. of the cases charted were of 5 days' duration; by eliminating those of both 4 and 5 days' duration, we would reduce the number of beneficiaries 22 per cent. and so on up to two weeks, which is usually as far as waiting time goes in either associations or under compensation laws. This would eliminate 65 per cent. of the beneficiaries in addition to the cases of less than 4 days' duration which are not charted. This shows the importance of these factors to the costs of workmen's compensation.

Permanent Disability

For permanent disability, no accurate data covering a wide number of associations is available. However, the experience of the Dodge Association indicates that 2 cents per week from each member, in addition to dues covering the first 52 weeks, will enable the association to pay 25 cents per day (larger amounts in proportion) for total disability so long as it may last after the regular 52 week period has ended. Like all other rates given, one-third of the rate named is a loading for a margin of safety.

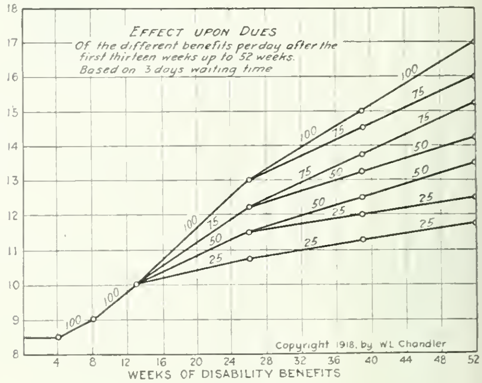


CHART 22

This covers disability only and not dismemberment benefits which in work accidents are covered by compensation.

Dismemberment Benefits

A benefit of $50 each for losses of hands, feet or eyes, apparently could be covered if desired by general dues for all members of $1\frac{1}{2}$ cents per week (other amounts in proportion).

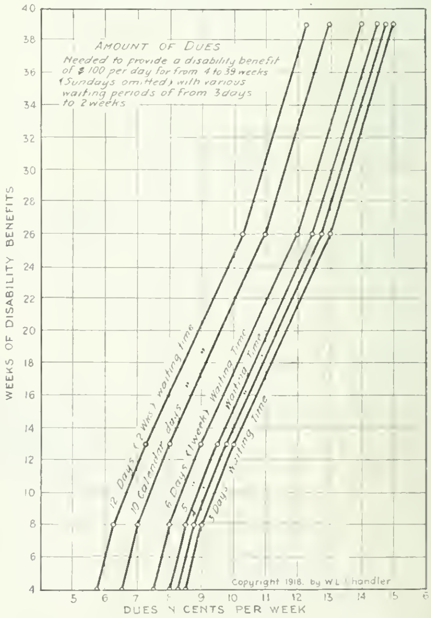


CHART 23

Compensation takes care of those items due to work accidents and a permanent disability benefit would cover time off due to such losses as blindness, etc., so that it seems the dismemberment benefits are not particularly needed.

DEATH OF MEMBER

For each $50 to be paid to beneficiaries at death of members the dues each week should be 1¼ cents from all members. All members should be required to take some death benefit for the sake of holding rates down and to insure at least a burial fee; $100 is the most favored death benefit, and should cost not to exceed 2½ cents per week for each member.

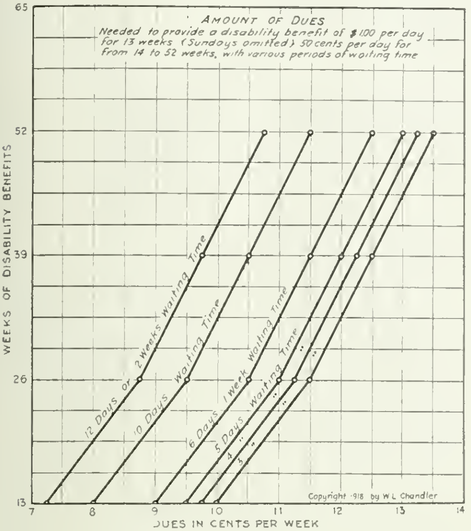


CHART 24

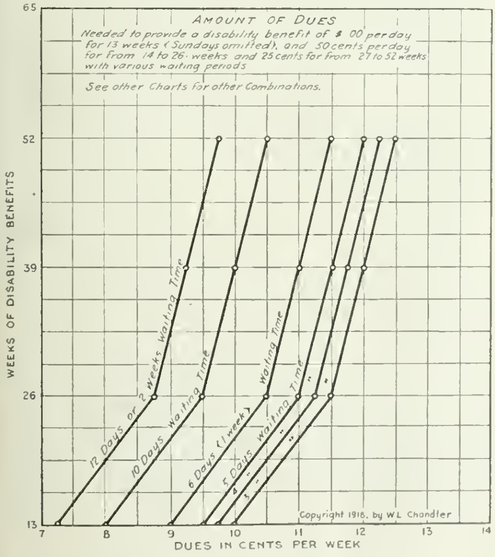


CHART 25

DEATH OF WIFE

If both single and married men, in other words all members, were willing to pay a flat rate the loading for each $50 benefit payable at death of a wife of a member should be about 1 cent per week.

However, if married men only pay for such benefits, the rate should be not to exceed 3 cents per week for each multiple of $50. I feel sure that this rate can be reduced as soon as we have more accurate data from which to work.

DEATH OF CHILD

If all members are willing to pay a flat rate regardless of whether they are single or married, with or without children, 2 cents per week should be charged for each multiple of $50, regardless of the number of children under 16 years of age in any one family. However, if these dues are to be paid only by those members having children, then the rate should be not to exceed 4 cents per week for each child over 2 and under 16 years of age for each multiple of $50.

On a restricted number of members, I cannot recommend covering children under 2 years until more accurate data becomes available, but I feel sure that this rate can better be reduced as experience dictates.

SOCIAL BENEFITS

Several employees' benefit associations operate some form of social adjuncts, but each depends upon the local situation. The Dodge Association consolidated with the Dodge Club recently and the members now must all subscribe for some amount of disability and death benefits and may include the club benefits if desired, just as they may include benefits for deaths of wives or children. In the Dodge organization, the corporation pays the rent of the club rooms and furnished the original equipment at the time the club was organized. The corporation also pays the salary of the steward so that the dues of 5 cents per week are devoted solely to entertainments, etc.

EXAMPLES OF FLAT RATES

COMBINATION NO. I

	Dues per week
$1 per day disability benefit after third day, and for not to exceed 4 weeks	$0.085
$100 at death of member	.025
Total per week	.11

NO. IA

$1 per day disability benefit after third day, and for not to exceed 4 weeks	.085
$100 at death of a member	.025
$50 at death of wife (all members pay same)	.01
Total per week	.12

NO. IB

$1 per day disability benefit after third day, and for not to exceed 4 weeks	.085
$100 at death of member	.025
$50 at death of wife (married men only paying)	.03
Total per week	.14

NO. IC

$1 per day disability benefit after third day, and for not to exceed 4 weeks	.085
$100 at death of a member	.025
$50 at death of wife (all members pay same)	.01
$50 at death of child (all members pay same)	.02
Total per week	.14

* * * *

COMBINATION NO. 2

	Dues per week
$1 per day disability benefit after third day, and for not to exceed 10 weeks	$0.095
$100 at death of member	.025
Total per week	.12

COMBINATION NO. 6

	Dues per week
$1 per day after third day for first 13 weeks	
$0.50 per day for next 13 weeks	
$0.25 per day for next 26 weeks, total 52 weeks	$0.125
$100 at death of member	.025
Total per week	.15

NO. 6A

$1 per day after third day for first 13 weeks	
$0.50 per day next 13 weeks	
$0.25 per day next 26 weeks, total 52 weeks	.125
$100 at death of member	.025
$50 at death of wife (all members pay same)	.01
Total per week	.16

NO. 6B

$1 per day after third day for first 13 weeks	
$0.50 per day next 13 weeks	
$0.25 per day next 26 weeks, total 52 weeks	.125
$100 at death of member	.025
$50 at death of wife (married men only pay)	.03
Total per week	.18

NO. 6C

$1 per day after third day for first 13 weeks	
$0.50 per day next 13 weeks	
$0.25 per day next 26 weeks, total 52 weeks	.125
$100 at death of member	.025
$50 at death of wife (all members pay same)	.01
$50 at death of child (all members pay same)	.02
Total per week	.18

NO. 6D

$1 per day after third day for first 13 weeks	
$0.50 per day next 13 weeks	
$0.25 per day next 26 weeks, total 52 weeks	.125
$100 at death of member	.025
$0.25 per day for total disability as long as it lasts (all members pay the same)	.02
Total per week	.17

* * * *

COMBINATION NO. 7

$1 per day after third day for first 13 weeks	
$0.50 per day next 39 weeks, total 52 weeks	$0.135
$100 at death of member	.025
Total per week	.16

NO. 7A

$1 per day after third day for first 13 weeks	
$0.50 per day next 39 weeks, total 52 weeks	.135
$100 at death of member	.025
$50 at death of wife (all members pay same)	.01
Total per week	.17

NO. 7B

$1 per day after third day for first 13 weeks	
$0.50 per day next 39 weeks, total 52 weeks	.135
$100 at death of member	.025
$50 at death of wife (married men only paying)	.03
Total per week	.19

NO. 7C

$1 per day after third day for first 13 weeks	
$0.50 per day next 39 weeks, total 52 weeks	.135
$100 at death of member	.025
$50 at death of wife (all members pay same)	.01
$50 at death of child (all members pay same)	.02
Total per week	.19

NO. 7D

$1 per day after third day for first 13 weeks	
$0.50 per day next 39 weeks, total 52 weeks	.135
$100 at death of member	.025
$0.25 per day for total disability as long as it lasts (all members pay the same)	.02
Total per week	.18

* * * *

COMBINATION NO. 8

$1 per day after third day for 26 weeks	$0.13
$100 at death of member	.025
Total per week	.155

COMBINATION NO. 11

	Dues per week
$1 per day after third day for first 26 weeks	
$0.75 per day next 13 weeks	
$0.50 per day next 13 weeks (total 52 weeks)	$0.155
$100 at death of member	.025
Total per week	.18

NO. 11A

$1 per day after third day for first 26 weeks	
$0.75 per day next 13 weeks	
$0.50 per day next 13 weeks, total 52 weeks	.155
$100 at death of member	.025
$50 at death of wife (all members pay same)	.01
Total per week	.19

NO. 11B

$1 per day after third day for first 26 weeks	
$0.75 per day next 13 weeks	
$0.50 per day next 13 weeks, total 52 weeks	.155
$100 at death of member	.025
$50 at death of wife (married men only paying)	.03
Total per week	.21

Other combinations may be built up at will from Charts 16 to 25 inclusive.

Following is an excerpt from the Dodge by-laws showing how this may be done:

	1 Unit	2 Units	3 Units	4 Units
A. Temporary Disability Benefits for not to exceed thirteen weeks for one disability, nor more than twenty-six weeks in any one calendar year				
Benefit for each week day after the first 3 days	$0.50	$1.00	$1.50	$2.00
Amount of dues per week for this benefit	.05	.10	.175	.25
B. Death of member				
Benefit to be paid at death of member	50.00	100.00	150.00	200.00
Weekly dues for this benefit	.015	.025	.045	.06
C. Death of wife of member provided she lived in the United States at time of her death	50.00	100.00	150.00	200.00
Weekly dues for this benefit	.03	.05	.09	.12
D. Death of dependent child over 2 years and under 16 years of age				
Benefits in excess of $50 may not be taken for children under 6 years of age				
Benefit to be paid for each child at death	25.00	50.00	75.00	100.00
Weekly dues for each child	.02	.04	.06	.08
E. Club benefits including use of club rooms and such privileges as go with them				
Weekly dues for club privileges				.05

TABLE 8 AMOUNTS WHICH MAY BE DEDUCTED SAFELY from dues shown in various charts and tables based on 3 days' waiting time, provided waiting time is increased as shown.

Number of week or work days at start of period of illness for which no benefits are paid (waiting time)		Amount which may safely be deducted from weekly dues quoted as upon a basis of three days' waitin time, in cents	
	3	Use rates quoted for three days' waiting time	
	4	deduct	$0.0025
	5	"	.005
1 week or	6	"	.01
1 week and 1 day or	7	"	.015
	8	"	.0175
10 calendar days or	9	"	.02
10 working days or	10	"	.0225
	11	"	.025
2 weeks or	12	"	.0275
	13	"	.03
2 weeks and 2 days or	14	"	.035

What is a Good Concrete Floor?

The Important Quality of Dustlessness is Obtained from Best Materials and Good Workmanship

By Leonard C. Wason

From many viewpoints the floor is one of the most important parts of the concrete factory building. From a wide experience in concrete construction, the author gives the essentials of such a floor, tells how it should be constructed and points out method of treatment for floors that are unsatisfactory in use especially because of dustiness. The advantages and uses of so-called hardeners are also fully discussed.

Mr. Leonard C. Wason *has been continuously engaged in engineering work since his graduation from the Massachusetts Institute of Technology. Since 1891 he has been a pioneer in the field of reinforced concrete construction and has been responsible for the design and erection of many millions of dollars' work of concrete work. The Aberthaw Construction Company, of which he has been president since 1895, has specialized in many kinds of concrete construction for the past 25 years.* Mr. Wason *is past president of the American Concrete Institute and is a member of the American Society of Civil Engineers.*

DOUBTLESS no feature of modern concrete factory buildings has been the subject of more controversy than the floors. Wearing qualities, dusting, cleanliness; repairs, waterproofness, noise, attachment of machines, breakage of manufactured products, all these and many other elements have entered into the discussion. The really important elements, however, are merely phases of the same quality or lack of quality in a concrete floor, namely, that of dushtlessness or dustiness.

In the final analysis, a good floor is one that is free from annoying dust and one that will withstand wear of any kind for a very long period of time. Obviously, dustlessness is a relative term, for the amount of dust that would be readily tolerated in the foundry would be ruinous to work carried on in a watch factory, a calendar room, or a paper coating and drying room.

In the absolute sense there is no such thing as a dustless floor. But in the usual acceptance of the term a dustless floor is one which wears away so slowly that dust is not seen nor does it accumulate in sufficient quantity to injure any product or interfere with any operation in proximity to it.

Manifestly, the floor that wears most will be the most difficult to keep clean and will most frequently call for repairs. The very process of making what looks exceptionally fine in the way of a trowelled granolithic surface tends very materially to decrease its wearing qualities.

Natural Stone Best Resistant to Wear

It is generally recognized that Portland cement is less resistant to wear than good natural stone. What is more, the fine sand or stone dust which contributes to the beauty and apparent perfection of the granolithic surface is readily ground to dust. It must, therefore, be evident that the way to avoid a dusty floor is avoid very fine particles.

A smooth and finely finished concrete floor wears readily because its surface is composed almost entirely of fine cement. The wear should be thrown directly upon the largest possible pieces, like trap rock forming a part of the aggregate, associated with just enough cement or mortar to hold them firmly embedded. Obviously, a floor in which the pebbles or chips of stone are exposed to view is lacking in that beauty of finish which obtains when there is an excess of cement brought to the surface and carefully smoothed by the troweling process. But it has in it the elements of permanence. In fact, no matter how good the body of a granolithic floor may be, it does not become effective until the upper coating of fine material has been worn off. Hence, the surface coating should be made just as thin as possible.

The smallest particle of stone that will stand ordinary wear, in the writer's opinion, is about ⅛ inch in diameter. This, if of hard stone, is sufficient to take the weight of a four-wheeled truck carrying a load of 1000 pounds. Such a wheel with a 2-inch face would have a bearing of about 2 inches by 1/32 inch, or about 1/16 square inch, which is about four times the exposed surface of the stone in question. If the wheel bore uniformly across its area there would be little chance for abrasion; on a point it would abrade.

To get a surface that is as free as possible from abrasion the aggregate must be proportioned so that as large a portion of the surface as possible is stone. With care a surface of 90 per cent. stone and 10 per cent. cement can be had. The cement, which wears a little faster than the stone, wears to a trifle lower level so that the stones really get the major part of the wear.

Causes of Dustiness

There are several conditions independent of the aggregate that will render a floor dusty. If the mortar is mixed too dry it will be porous and the aggregates will tend to work loose because of insufficient bonding. On the other hand, the quality of the surface is almost certain to be impaired with resulting tendency to dusting if exposed to too rapid drying. The effect of too much water in the mortar is to bring the fine particles of cement to the surface together with a soft, spongy substance from the cement known as "laitance" which wears rapidly. Furthermore, this excess of water has to be removed by evaporation or sprinkling of sand and cement with consequent delay in the finish and setting. This delay is essentially harmful to the surface.

Largely because of improper workmanship or treatment in the laying of floors, and the necessity of their improvement, so-called hardeners have become quite popular. But they have not been used sufficiently long to prove that they are universally good and always remedy the trouble. It can be safely said, however, that they do materially relieve dustiness and, in general, if the floor turns out to be dusty in spite of much care it is probably a wise thing to use some type of hardener. All have some merit and none have been absolutely discredited, although none stand out head and shoulders above the others.

Concrete Floor "Hardeners"

Unfortunately, the word "hardener" is a misnomer and leads to a good deal of confusion; in reality and primarily such a substance is merely a dust preventive

The inaptness of the word is particularly noticeable when it is applied to liquids whose service is primarily that of dust laying.

Hardeners are designated by various manufacturers as preservatives, designed to render concrete waterproof, dustproof, wearproof, hard, etc. Some are dry in the form of powder, others liquid, oily, waxlike, or of other consistency. Some are recommended for incorporation in the entire body of the upper course, or topping, of the concrete thus forming an integral part of it. In the opinion of the writer, based on long years of experience, this is improper practice. Fundamentally, a hardener is of no value when so used; its real utility is only displayed when it is employed as a palliative remedy or cure for a floor that is laid wrongly. The true province of the hardener is in surface treatment.

The trouble with many preparations for curing dusting of concrete floors is that they are only temporarily effective. Thus any kind of paint will for a time give fair results, but only so long as it remains as a separate film upon the surface. It does not enter into the concrete itself, is soon worn off and the surface left in practically the same condition as before.

The use of integral hardeners like fine iron filings should be avoided because the particles are finer than are permitted in the aggregate and are therefore practically dust in themselves. The result is like that of increasing the proportion of sand which has a weakening effect.

The methods of application of the hardeners on the market vary according to the nature of the material. For floors taking relatively light wear a dry mixture is made of a certain hardener and cement sprinkled evenly over the surface as a finish, floated in and thoroughly troweled. For heavy service a larger proportion of this hardener is recommended to be mixed with cement, sand and water as topping and then the finish applied by sprinkling dry as in the case of the lighter floors, followed by thorough floating and troweling.

No Substitute for Best Materials and Good Workmanship

But, when all is said and done, in the opinion of the writer the best hardening preparation for a cement floor is composed of equal parts of *care*, *cement* and *water* used when the floor is built. In a word, nothing will serve as a substitute for the best of materials carefully selected and that degree of skilled workmanship which insures their proper manipulation.

After proper selection of the aggregates and thorough mixing, the mortar for the finish is dumped in bulk from wheelbarrows or other conveyances, spread roughly with a shovel, then straightened as nearly as possible to a true surface. This leaves the floor with slight inequalities which do not catch the eye and which are removed by "floating." In this process the finisher feels a hollow and fills in mortar, floating it to a surface. A trowel which is of metal does absolutely nothing but smooth the surface, but the wooden float compacts the surface, makes it denser and thereby improves it structurally.

Floating is done shortly after the material is spread. As it approaches the time of final set the surface is smoothed with a slight troweling which improves its appearance but it likely to bring up fine stuff which makes the surface dusty. Omitting this operation leaves a floor which is not so pretty to look upon but is much freer from dust and therefore more satisfactory notwithstanding the slight inequalities that remain in the surface.

To avoid a surface that is likely to dust easily the troweling should be reduced to a minimum, because this brings up an excess of fine particles and is frequently done so late in the hardening process that the setting is disturbed and the strength impaired.

The maximum thickness of the upper layer thus brought to the surface, and which is really the source of all dusting, is seldom more than 1/32 inch, frequently less. In fact, the real dusting problem may be said to be only 1/32 inch thick. Decreasing the troweling results in reducing the top surface so that it wears more quickly to the real floor.

The tendency to dust can be greatly reduced by careful curing of the floor. This consists in covering the surface with something which will hold water, like sawdust, shavings, sand or bagging and keeping the surface thoroughly wet and protected from the sun and wind for a period of one week, preferably ten days from the time it is laid.

Treatment for Dusty Floors

If, after all ordinary precautions have been taken to prevent dusting, the floor is still dusty then surface treatment of some kind should be applied to remove the surface skin which does not exceed 1/32-inch, or to properly treat it. One way is to grind this off by hand or by power as a terrazzo floor is polished. Other methods are to apply liquid coatings of various kinds. One of the most satisfactory treatments is boiled linseed oil thinned somewhat with gasoline to such a consistency that it will penetrate the pores of the surface. If one coat does not cure the trouble generally two will.

A second method is to clean the surface thoroughly and then apply a coat of silicate of soda or water glass, 40 degrees Baumé, diluted one part to six of water, to seal the surface. Then wash off the excess which opens out the pores again and apply a second coat.

Effect of Heavy Trucking

A properly laid concrete floor will resist all ordinary trucking which is the commonest and most active cause of serious wear on granolithic floor surfaces. The small diameter and the narrow and flat face of the usual truck wheel are most conducive to harmful effect upon the floor. When a flat-wheeled truck turns, the edge of the wheel scrapes into the surface because the load tends to tip the truck toward the outside of the circle on which the load is turning, bringing the heaviest pressure toward the outer edge of the wheel. Such is the wear that concrete floors commonly get. Of course, a slightly crowning wheel or one with a tread of rubber, fibre or wood will eliminate this difficulty. Recent improvements in trucks are doing much to overcome the difficulties.

A curiously illogical practice still persists in the jointing of floors. Where the top course is laid over an already rigid base of slabs or reinforcel areas it should obviously be so bonded thereto as to be integral with it. As a result no location for possible cracks can be predetermined by merely jointing the comparatively thin upper course. Although more unsightly, it is far better to allow the cracks to come where they will.

But more important as a reason for not jointing floors is the effect that the process has upon the wearing qualities under heavy trucking. The regularly spaced and open grooves offer a ready opportunity for breaking back into the surface when local pressure is exerted, or small pieces of material act as wedges when caught in these grooves and thus assist in the splitting process. Furthermore, the joints furnish a lodging place for dirt and contribute to the ill effects of dusting and uncleanliness.

British Shell-Shop Handling Devices-III

Shop Practice in Moving and Conveying 4.5, 6, 8, 9.2, and 12-inch Shells

By George Frederick Zimmer

After describing the application of hydraulic cranes and large transporters, the author takes up approved methods for handling the various sizes of shells not only for the machining operations, but also for other manufacturing processes as marking, varnishing, backing and inspecting. He goes still further and shows how shells, fuses and primers are handled in a national filling factory which turns out the shells "ready for general service."

Mr. George Frederick Zimmer *was associated for fifteen years following 1882 with Mr. James Harrison Carter, the well known pioneer engineer of English roller milling. In 1897 he started practice as a consulting engineer, and at the same time began to market a reciprocating steam conveyor of his own development. He is an extensive writer on the art of mechanical handling of materials and is the author of two books, "The Mechanical Handling of Material, published in 1905, and "The Mechanical Handling and Storing of Material During and After the War," published in 1917.*

HYDRAULIC shell cranes are sometimes employed in connection with the copper-banding presses when handling shells of the heavier sizes. These cranes consist of a radial jib made from a length of an I-beam; the jib is carried at the inner end by a vertical hydraulic ram and is held and guided by tension rods so that the whole jib with its load can respond to the somewhat limited lift of the ram. The running head or trolley which supports the shell in a vertical position (ready to be lowered into the copper-banding press) travels on the upper flange of the I-beam. The trolley or bogie from which the shell is suspended has two running wheels, but there is no mechanical travelling gear, neither is there any mechanical slewing. Both of these operations are performed by hand.

These hydraulic cranes are each controlled by a single valve which neither puts the cylinder under pressure or to exhaust and accordingly cause the jib with its shell to rise or fall. A diaphragm is provided in the exhaust to prevent a too rapid descent. These cranes have proved convenient and expeditious in the handling of shells by girls.

Crane Bridge Transporters

For the purpose of handling the raw material and loading the finished shells into railway trucks two large bridge crane transporters traverse the space of the railway siding in front of one large munition factory. See Figure 66. In addition to this, material is conveyed through the shops by railways, there being about 3¼ miles of standard-rail track through this factory. The above-mentioned transporters are each built for 3-ton net loads and deal with the incoming raw materials and the outgoing projectiles.

Though presenting, at a casual glance, no unusual features, these transporters possess some uncommon attributes. Their action is rapid and their capacity therefore large. The total length of each bridge crane is 188 feet and the total traverse 180 feet. The two rail-tracks which support the cranes are 90 feet apart, so that the crane overhangs the rails at each end by 49 feet. The length of the track in front of the works is 600 feet, so that a rectangular area of 100,000 square feet is covered. Each transporter is manipulated by three electric motors, one for hoisting, one for travelling the trolley, and one for travelling the crane bodily. The hoisting motor is of 15 hp. capacity, the travelling motor 8 hp., while the motor for travelling the bridge crane is of 60 hp.

The speeds of working with a full 3-ton load are: Hoisting, 50 feet per minute; travelling, 300 feet per minute, either lengthwise or crosswise. The motor which travels the transporter is controlled by the driver in the trolley, but it is located in the centre of the span of the bridge and revolves two of the driving wheels on each leg by shafting, spur and bevel gearing. The trolley with the driver's cab is carried on rails from the underside of the main girders; the gage of the rails is

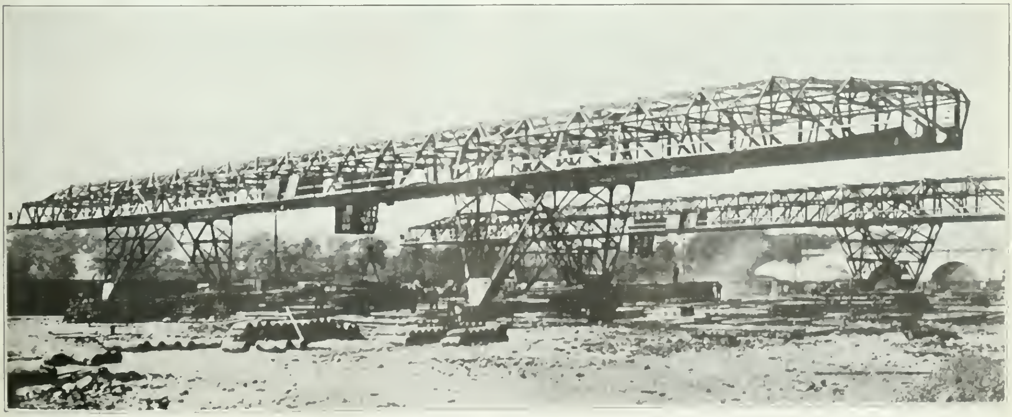


FIG. 66. PHOTOGRAPHIC VIEW OF TWO BRIDGE CRANE TRANSPORTERS IN FRONT OF A NATIONAL MUNITION FACTORY, HANDLING RAW MATERIALS AND FINISHED SHELLS

5 feet 8 inches and the height of the lift between floor and cab is 40 feet. The load is lowered on a hand-brake by gravity. The motions of the trolley are very similar to those of the telpher machines described previously, with their cut-outs, limit-switches, etc., for the hoisting and travelling motors. The controllers are of the upright tramway metallic type with metallic resistances. The builder of these bridge cranes is Messrs. Stothert & Pitt, Ltd., Bath.

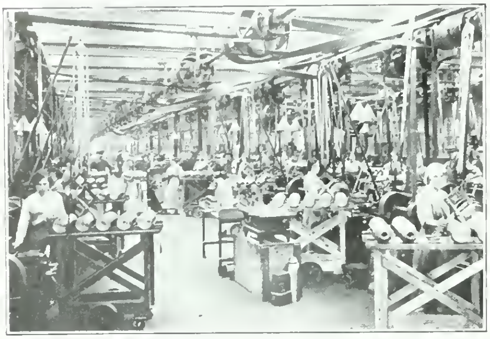


FIG. 67. GENERAL VIEW OF 6" SHELL FACTORY, SHOWING METHOD OF HANDLING

How 6-Inch Shells Are Handled

Having now described the methods employed in handling shells, I will give in the following paragraphs some typical examples of handling shells of different calibre in factories.

The handling problem has been solved in one factory where 6-inch shells are manufactured by the introduction of an extra light jib crane fitted to each machine tool in connection with suitable gripping tongs. In addition to this an especially designed shell truck is used; it holds five shells and is at the same height as the more usual rolling benches in other factories, in fact it might almost be designated a portable rolling bench. These trucks are quite inexpensive, are manufactured on the spot of soft wood without dovetailing, mortising, or even screwing: they are simply nailed together and have a pair of wheels in their central axis and four small castors, one at each corner. Figure 67 represents a general view of this shop; the light cranes and the shell trucks can be seen.

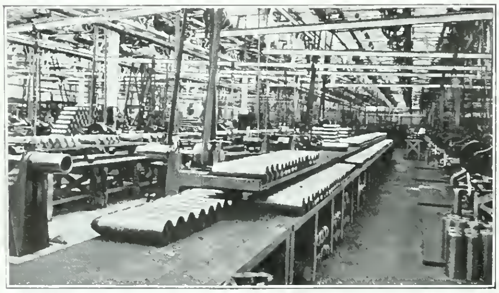


FIG. 68. GENERAL VIEW OF A SCOTCH 8" SHELL SHOP, SHOWING EMPLOYMENT OF ROLLING BENCHES AND SMALL OVERHEAD CROSS RUNWAYS

The shell forgings are received by rail and unloaded by a crane, five at each trip. They are supported by a contrivance having five long prongs or hooks supported on five short chains which are joined together in one ring. Each hook or prong holds one of these hollow forgings. Every batch of five shells is deposited on one of the trucks just described, which is then wheeled into the shop and the forgings conveyed from machine to machine for the different operations. When the first process has been completed on one batch of five shells they are examined before they are allowed to pass to the next tool for further development work on them.

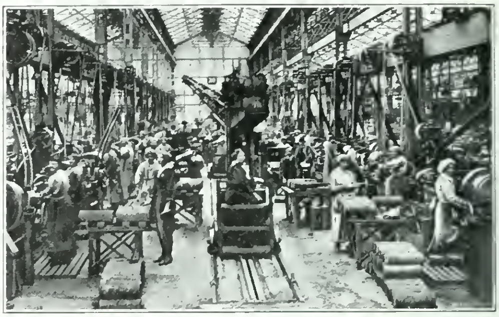


FIG. 69. GENERAL VIEW OF BAY IN SHELL SHOP FOR 6 INCH AND 9.2 INCH SHELLS, WITH HANDLING BY HAMMER-HEAD CRANE

It has already been stated that in this factory each of the machines is provided with a light crane and gripping devices with which a shell is transferred from the tuck to the lathe and back. Some of the machine tools are specially built and so arranged that they can do their part on a batch of five shells while they are reposing on one of these trucks, to this end these special tools are suspended from the roof at such a height that the truck can be wheeled underneath and the shells operated upon after a simple adjustment of the tool without any handling whatever.

The weighing of the shells is performed in a similar manner. The truck with its load of five is wheeled underneath a beam scale and one shell at a time is picked up by a gripping device suspended from one end of the beam, while the other end supports the standard weight, 85 pounds 4 ounces. The number of ounces the shell is heavier is then marked on it with chalk.

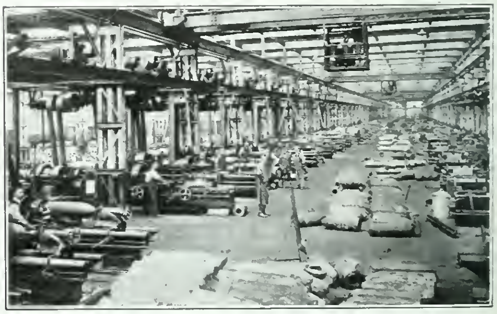


FIG. 70. GENERAL VIEW OF BAY IN 12-INCH SHELL SHOP, HANDLING BY OVERHEAD TRAVELING CRANES, THREE OF WHICH CAN BE SEEN

The usual method of marking the base of the shells is adapted to the same system by a specially designed machine for this purpose. The truck with its five shells is wheeled under this machine and is adjusted in turn to each shell—by girls—and marked without removal from the trucks. This arrangement saves all handling.

Cleaning and varnishing is the only operation which is performed in this shop on rolling benches. The shells are cleaned with a mop soaked in turpentine and then rolled into gas heated ovens where they are warmed to about 100 degrees F., after which they are sprayed, are allowed to stand for two hours, and at the conclusion of the operation are delivered into bond.

Handling 8-Inch Shells

In a Scotch munition factory where 8-inch high explosive shells are manufactured they are handled entirely on rolling benches during the whole of their sojourn in the shop. The raw forgings are received at one end, passed down the shop in three double rows in parallel streams and emerge finished at the other end. The shells weigh over 200 pounds each, and although the operatives are mostly women, this method of handling does not overtax their strength. There is a rolling bench between each double row of machine tools and one at the outside beyond the two extreme rows; the tops of these benches are at approximately the same level as the shears of the machine beds. The wooden skid already mentioned is used here; see Figures 1 and 2, page 270 of the April issue. The end where the shell comes to a stop is fitted with simple ball races, and if the end of the skid is adjusted to suit the height of the centre of the lathe the shell can be slipped readily into position, as it can be turned around on the ball races.

In some cases instead of these wooden skids the shells are lifted from the rolling benches by means of tongs and chain tackle suspended from short overhead cross runways, each of which serves two machine. Some of the rolling benches formed with a gap which accommodates an automatic weighing machine and the platform is provided with rails at the same level as the rolling bench to permit the shells to be rolled on to the weighing machine. Where two streams of shells have to be transported in opposite directions on these benches one stream is rolled on a subsidiary bench, superimposed on the main bench which accommodates the other stream; this is illustrated in Figure 68.

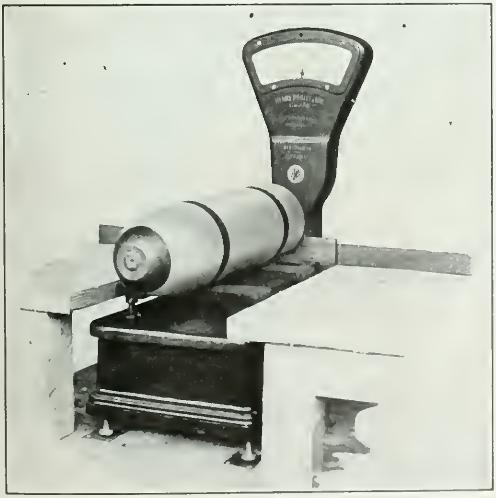


FIG. 71. AUTOMATIC SHELL WEIGHER, FORMING PART OF ROLLING BENCH

The operation of varnishing the interior of the shells is also performed by means of a spraying pistol while they still repose on the bench. The shells are afterward raised and suspended in pairs from suitable carriers on an overhead runway; in this position they are pushed by hand past an operator who spray paints them. As soon as a sufficient number have thus been painted to fill one of the four divisions of the stoving or baking chamber they are baked, and afterward leave the oven at the opposite end, where they are allowed to cool, after which they are removed from their hanging position and transported again on the benches.

Handling 9.2-Inch Shells

For handling 6-inch and 9.2-inch shells it is found expedient to install in addition to the overhead travelling crane of the usual type some lighter, quicker and more portable cranes; a particular favorite, in addition to the telpher which I have already mentioned, is a floor crane of the hammer-head type. It travels along the centre of each aisle on rails and the jib reaches to the lines of lathes on each side. It feeds the machine with single shells lifted from trucks, benches, or from the floor, see Figure 69. These cranes which have already been described can turn a complete circle and are equally suitable for both 12 and 9.2-inch shells. The overhead travelling crane is more particularly used for handling larger batches of shells in tubs, see Figures 38 and 39, or the lifting devices, Figures 48, 51 and 52, pages 363 and 364 of the May issue.

The Pickering hand-jib crane is also frequently used in lifting the shells from a nearby bench at the level of the lathe spindle, which is kept supplied with shells by the hammer-head crane or the overhead travelling crane. It lifts 200 pounds. The overhead travelling cranes are generally designed for 2-ton loads, span of 30 feet, a travelling speed of 300 feet and a hoisting speed of 100 feet per minute. All the cranes mentioned above are driven by girls except the overhead travelling crane when handling hot billets and forgings to the presses, in which case it is driven by men.

At the copper-banding presses electrically operated jib cranes are employed and not the hydraulic ones already mentioned. They have a radius of 20 feet 6 inches and lift at the rate of 25 feet per minute. The whole of the crane equipment throughout this factory is provided with limit switches which cut out and thus prevent overwinding, and the hammer-head cranes have, in addition, underwinding cut-outs.

Handling 12-Inch Shells

When handling 12-inch shells the rough forgings generally enter at one end of the shop and are unloaded on a number of low wooden benches or trestles which correspond in number with the rows of lathes. The forgings are rolled on these to the first lathe, where they are lifted by an overhead travelling crane into the lathe for the first operation. This is repeated from process to process and care has even then to be taken to use as much rolling as possible in order not to employ the crane more than is necessary. This precaution emphasizes the limitations of the overhead travelling crane, as we generally find some smaller jib cranes employed alongside it. A munition factory with overhead cranes is shown in Figure 70.

When the shells leave the band-turning machine they are rolled again on benches into the company's inspection department and then into the government room; after passing the inspectors they are hoisted on an endless, or closed, monorail runway on which they pass through the cleaning, painting and varnishing shops, and after having been baked are again rolled into the final government inspection department and then loaded into railway trucks.

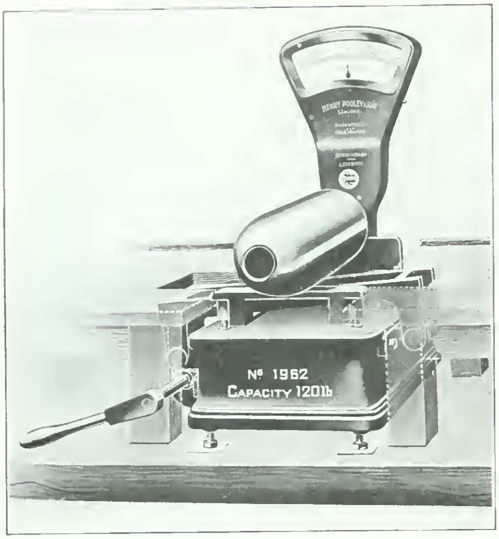


FIG. 72. AUTOMATIC SHELL WEIGHER, FORMING PART OF ROLLING BENCH, BUT FITTED WITH A RELIEVING APPARATUS

WEIGHING OF SHELLS

The weighing of shells is an important performance in the routine of a projectile factory, and is generally carried out on the rolling benches in which suitable recesses for the weighing machines are provided. The smaller shells up to 6-inch are usually rolled on the plane surface of the bench, of which the platform of the weighing machine forms a flush continuation with a slight recess for the shell to come momentarily to rest, see Figure 71. Figure 72 is the same machine fitted with a relieving apparatus, while Figure 73 shows a back view. The larger shells are often rolled along on a pair of runner rails, which in this case also are continued across the weighing platform, see Figure 74.

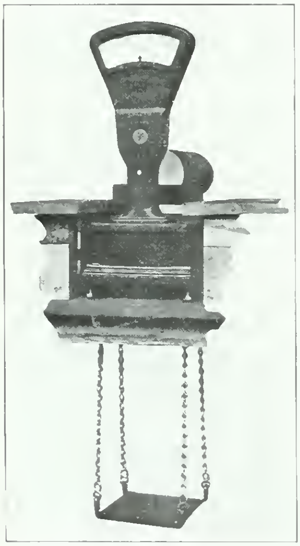


FIG. 73. BACK VIEW OF FIGURES 71 AND 72

All the machines are provided with a chart or index, which can best be seen on Figure 72. If the finger points to zero the shell is of the standard weight, if to any other position it indicates in ounces the amount by which the shell is deficient or in excess of the standard. For heavier shells the chart is graduated up to five pounds in ounce divisions on either side of zero.

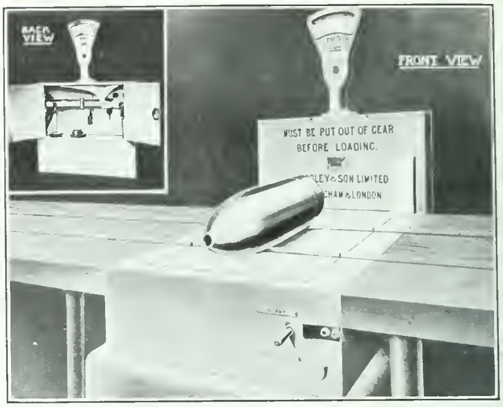


FIG. 74. WEIGHING MACHINE, FORMING PART OF ROLLING BENCH FOR BIGGER SHELLS

In Figure 75 a similar weighing machine for smaller shells, 3.3 to 4.5-inch, is shown. Here a shell of the correct standard weight, or its equivalent, is placed on the weight scale, and the shell to be tested on the goods scale. Any error under or over standard is shown clearly, accurately and instantaneously on the chart. The capacities for which these machines are built are 20 and 60 pounds. The weight of the machines previously described is suspended beneath the bench, as shown in Figure 73. The machine for 6-inch shells is for a capacity of 120 pounds, while those for larger shells are built for capacities of 3, 5, 10, 15 and 20 hundredweight. The size of the weighing platform is 2 by 3 feet, and these heavier machines are provided with a disengaging device to prevent excessive wear on the indicator, the machine must be put out of gear before a shell is rolled on. To adapt these larger machines for all conditions they are made both for bench work and to fit flush with the floor.

Figure 76 shows a 1-pound scale which is used for weighing small charges of amatol in filling factories. The chart is marked up to 1 pound by ¼ ounce divisions. All the working parts are above the load scale and are enclosed in a dust-proof casing, thus protecting them from the action of the amatol and giving a longer life of accuracy to the machine.

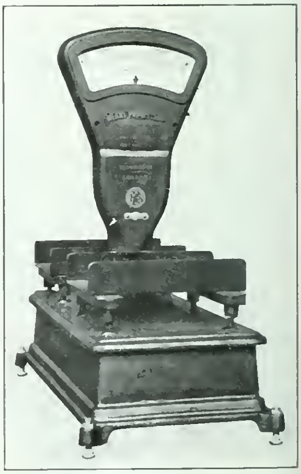


FIG. 75. AUTOMATIC WEIGHING MACHINE FOR SMALL SHELLS

Messrs. Henry Pooley & Sons, Ltd., of Birmingham, are the makers of these weighing machines which are used in all British munition factories.

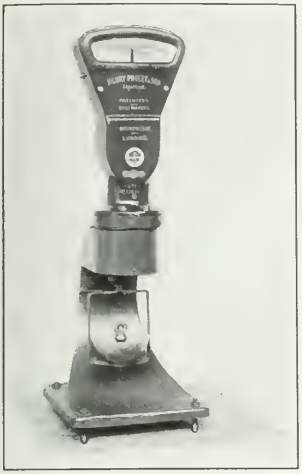


FIG. 76. AUTOMATIC WEIGHING MACHINE AS USED FOR AMATOL IN FILLING FACTORIES

INSPECTION OF SHELLS

The examination of shells before they are issued as "fit for general service" is a matter of the utmost importance and the problem of their handling from the factory to the "bond room" and subsequently to and from the benches deserves careful consideration. On the whole, what has been said concerning the handling in shops should apply here also. The same rolling and sliding methods are generally employed to handle shells to and from the inspectors.

It will not be out of place to include a few words concerning the general method employed in shell inspection, as it is not only the handling operation but also the whole routine which combine to make or mar the economy of the process. Shells are examined in the factory and when they are considered perfect from the foreman's or contractor's point of view, which may be somewhat biassed, they are afterward examined in the "bond rooms" which have been established and in which they are held in bond until "sentenced" by the inspection department.

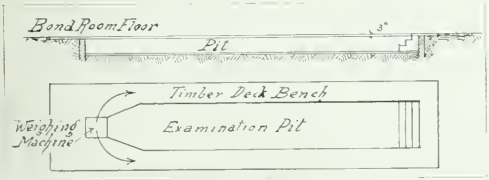


FIG. 77. EXAMINING PIT FOR LARGE SHELLS

The first consideration in the layout of a bond room should be the attainment of conditions to involve a minimum of handling. It must be borne in mind that an inadequate provision in this respect will not only mean unnecessary expense but will also cause confusion and impede the work of inspection. The area of the "bond room" is therefore divided into three parts: (1) Stacking accommodation for shells, etc., waiting to be examined; (2) adequate bench accommodation for the examiners, and (3) storage space for the shells, etc., which have already been examined.

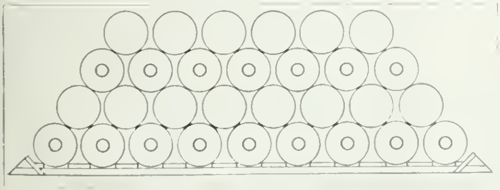


FIG. 78. METHOD OF STACKING SHELLS ON SKIDS

The accommodation for stacking shells to be examined should be equal to about half a week's output of the factory, while the space for inspected shells should be about equal to three weeks' output, as the inspection is not complete until after certain firing tests have been concluded. With these provisions in the bond room a continuous delivery of shells out of bond may be expected.

If for any reason the same door has to be used for bringing in store and for delivering the layout must provide for separate stacks for inward and outward store and for conveyance over separate gangways.

The height of the examining benches is also a matter of importance and these should vary according to the height of the shells. The best heights for benches for different sized shells, as given by an expert, are as follows:

	Height of bench.	
Size of shell.	Feet.	Inches.
18-Pounders	2	9
4.5-Inch	2	7
60-Pounders	2	7
6-Inch	2	6
8-Inch	2	3
9.2-Inch	2	1
12-Inch	1	10
15-Inch	1	7

AN INSPECTION PIT

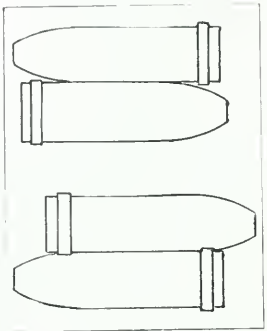
When examining large shells an improved method is now in vogue which provides an excavated pit instead of a table or bench, corresponding in depth with the bench height given above. The examiners stand in these pits so that all lifting of shells such as is necessary with tables is thereby avoided and consequently the use of cranes. The shells are wheeled upon hand trucks or rolled and placed at the edge of the pit, which is floored with 9 by 3-inch planks. In this way they are just as accessible to the examiners to use their gages as if they stood on the tables or benches. As many as four men can work in a pit 26 feet long by 5 feet wide, and can easily examine 360 shells in 10½ hours.

Figure 77 shows such a sunken inspection pit for 8-inch shells. It is fitted with a weighing machine at one end and both sides are used alternately, *i. e.*, while the shells are examined on one side those already examined are removed on the other, so that there is no waiting or loss of time.

Lifting by crane is avoided as much as possible in bond rooms, but it cannot be entirely dispensed with for the stacking of heavy shells. For stacking shells 8-inch and upward electrical runways of both the monorail and bottom-flange type are used, but for smaller sized shells they are not considered economical. Arrangements are, however, generally made for the smaller shells to be stacked as close to the examining benches as possible to obviate unnecessary labor.

Several stacking methods have been adopted, one of which is shown in Figure 78. This method is known as stacking on skids and is recommended for shells 6-inch and over. For smaller shells the bin system is preferred, as there is less tendency for the shells to fall forward. When stacking as shown in the illustration the skids consist of two laths with a distance piece between each two shells, the width of which is so chosen as to leave a clear inch between the shells, and as the upper tiers must be the same distance apart since they rest between the interstices of the lower tiers this clearance of one inch between the shells is maintained throughout the stack. This space of one inch is allowed for all sizes of shells above 6-inch. The width of this distance piece is: For 6-inch shells, 2 11/16 inches; 8-

inch, 4 3/16 inches; 9.2-inch, 5½ inches; 12-inch, 7 1/3 inches. Concerning the method in which the shells should rest upon each other, Figure 79 shows the correct way; whereas if stacked as in Figure 80 the upper shells will rest upon the driving bands or the lower layers of shells with a consequent risk of injury. The method shown in Figure 80 is incorrect. An example of a bond room for 18-pounder shells is shown in Figure 81, which explains itself. Figure 82 shows a diagram of a simple arrangement of a bond room in which the shells are rolled through an opening in the factory wall. The rolling system is imperfect unless suitable weighing machines are sunk into the benches in such a way that the level path of the shells is not impeded by them, the shells being rolled on to the weighing machine as simply and easily as they are rolled on the benches. One weighing machine is sufficient for a scheme laid out as in this illustration, and all shells can pass over it as they enter from the factory into the bond room. In this case the stack for unexamined shells is in the factory.



FIGS. 79 AND 80. ABOVE, CORRECT WAY OF STACKING; BELOW, INCORRECT WAY OF STACKING

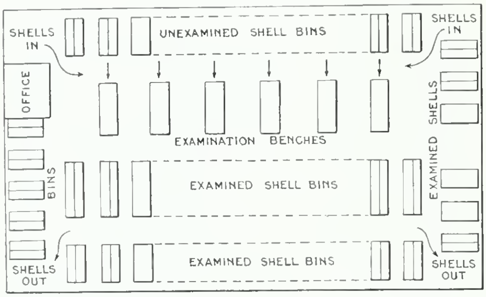


FIG. 81. DIAGRAM SHOWING LAYOUT OF A "BOND-ROOM" FOR 18-POUNDER SHELLS

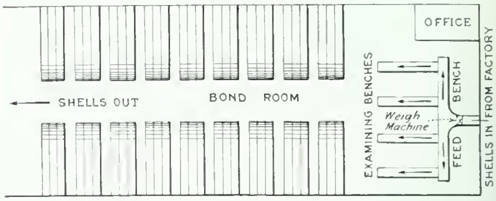


FIG. 82. FURTHER EXAMPLE OF "BOND-ROOM"

The method of rolling shells is recommended in bond rooms for 6-inch shells and upward, even for 60-pounders where all the handling is done by women. The method of sliding shells on well greased supports is also employed in bond rooms and where the table is intended to convey in one direction only a slight incline is allowed to lighten the task of moving them.

Inspecting Fuses, Primers, Etc.

Stores other than shells, such as fuses, primers, etc., which have to be handled in cases are transported on roller runways from place to place. In their examination auxiliary benches are required on which to open the cases, and others on which to nail them down again; these are frequently roller benches, they should be—according to the authority quoted before—2 feet 9 inches high.

Handling in Filling Factories

As an instance of the gigantic proportions attained by some of these munition factories, one might be mentioned, somewhere in England, covering an area of 400 acres, the actual floor space of the building being 1,000,000 square feet. Some thousands of tons of traffic pass daily in and out of the network of buildings, of which there are about 150, arranged in sequence in accordance with the operations to be performed. Thus the shells, etc., enter one building and after passing through certain processes enter the next, and so on. They are conveyed by mechanical conveyors, passing from building to building through gantries, never emerging into the open air and leaving the last of the buildings as completely filled shells "ready for general service." Within these works are 11 miles of railway and

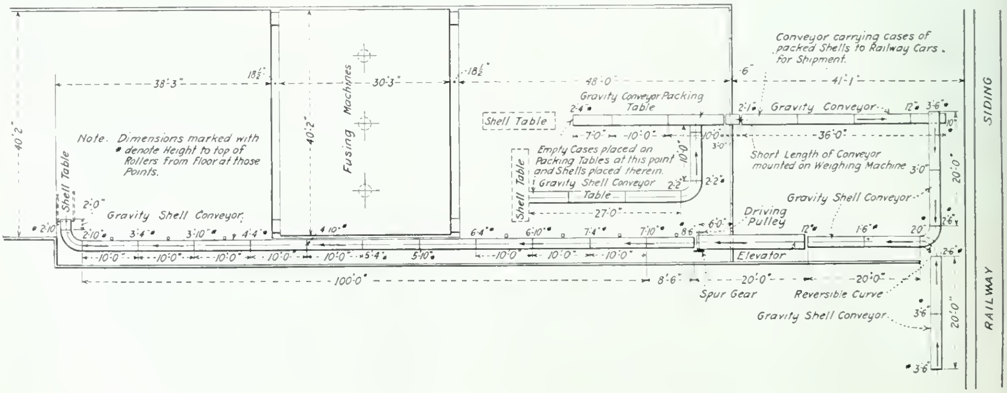


FIG. 83. DIAGRAM SHOWING ONE IMPORTANT SECTION OF A LARGE NATIONAL FILLING FACTORY

3½ miles of runways for handling the projectiles, not to mention miles of gravity runways. All connections between the buildings are enclosed so that no operative need ever go into the open and thus risk bringing in grit.

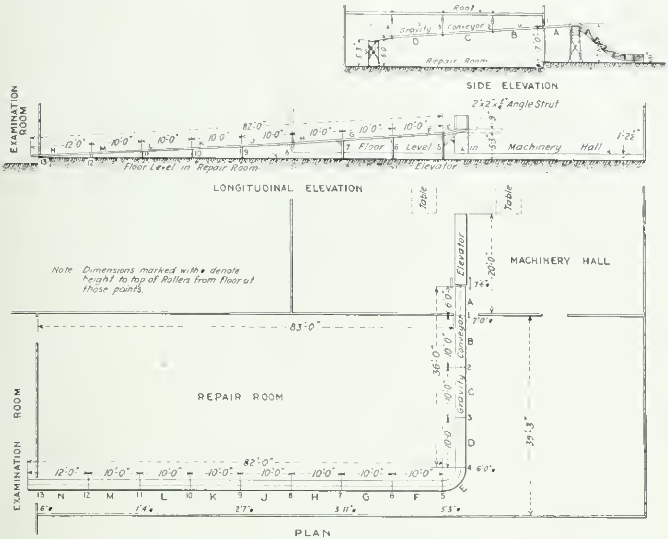


FIG. 84. USE OF GRAVITY RUNWAY IN NATIONAL FILLING FACTORY FOR HANDLING MUNITION BOXES

Examples of only small sections of these enormous works handling 4.5 and 6-inch shells during the filling process are given in the following:

The lay-out of No. 66 shell store is shown on illustration Figure 83. The shells arrive in railway cars from the filling department fitted with the ordinary temporary nose plugs, they are then placed by girls on the feeding terminals of the gravity conveyor, at the points shown, which carries them down to shell tables at the far end of the store, thereby eliminating hand trucking. The temporary plugs are here removed and the various operations are performed, such as putting in the wads and explosive bags and starting the fuses ready for screwing up tight. The shells are then placed on ball-bearing trolleys mounted on light rails which carry them to the "fusing machines" where the fuses are screwed up tightly. After this operation the shells are placed on another set of ball-bearing trucks which, in turn, carry them to the shell tables in the packing room, where, after a final examination, they are marked prior to being placed in boxes.

The empty boxes are put on gravity conveyor packing tables at the points indicated on the illustration, Figure 83, and the shells are placed in them; as the boxes pass along the roller conveyor each girl performs one of the operations tabulated hereafter before passing them on to the next operative. To economize in the use of wood the cartridges are now packed separately, in bags, protected with wooden lags, instead of in the boxes along with the shells, as was formerly done. Each girl is kept at one particular job, so that she becomes quick and efficient. The girls are stationed on each side of the packing table and the various jobs are apportioned as follows: Two girls place empty boxes on the conveyor and put shells therein, three nail lids in position, three nail lid wires to sides of boxes, two stencil boxes, giving final particulars of contents, two affix the Government labels, one girl attends to weighing of boxes and pushes them on to the gravity conveyor beyond, one keeps the table well supplied with empty boxes and lids.

As each girl completes her particular task she passes the box along the conveyor for the next operation, thus is no time lost by an operative having to put down her hammer and nails to take up labels and paste brush, or stencil and brush; neither need she walk about in search of shells and boxes; thus all walking time—which is wasted time—has been cut to a minimum, thereby increasing the output of the factory.

This method of handling and packing shells eliminates practically all hand trucking and carrying, thus lightening the tasks of the operatives. This installation is one of many supplied by the Alvey Fergueson Company (Inc.) of Manchester.

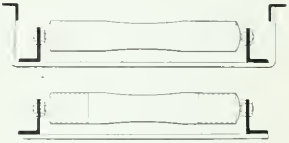


FIG. 85. TWO EXAMPLES OF GRAVITY RUNWAYS AS USED IN FILLING FACTORIES

Another installation, by the same engineers, is shown in Figure 84. It is provided with a roller elevator and a gravity conveyor carrying shell boxes from the machinery hall, where they are made, to the Goernment examination room, where all boxes are examined before being passed to the shell stores. The elevator has a capacity of 20 boxes per minute, though this can be doubled by putting two boxes between each pair of flight rails, which are 4 feet apart, making a total capacity of 40 boxes per minute. It has been found, from actual experience, that handling them at the rate of 10 to 15 per minute keeps the machinery hall quite clear of boxes and prevents the operatives being hindered in their work through an accumulation of finished boxes. The pathway upon which the boxes travel consists of protected rollers 4-inch pitch. The framework is of steel angles with the necessary braces and stays. It is gratifying to note that this installation—and similar ones—paid for itself within eight weeks of being set to work, by the amount saved in wages alone. The gravity conveyor in this plant is designed to carry boxes at the uniform rate of 60 feet per minute and the gradients are arranged accordingly.

It will be seen from the illustration, Figure 85, showing two cross sections of the varieties of the gravity conveyors in use, that they are strongly made and will withstand rough usage.

* * *

In conclusion, the author expresses the hope that the labor he has expended on the collection of the foregoing data may be of some little service to the American Allies, and that his little "bit" may be of some assistance in bringing this terrible war to a satisfactory conclusion.

American Women in War Industry--I

How Are They to Be Selected and Trained, and the Problems of War, Wages, Hours and Working Conditions

By C. E. Knoeppel

Twelve questions dealing with the problems of American women in industry were submitted by Mr. Knoeppel *to a number of manufacturers. In this article he gives a summary of the replies to those queries that deal with the items indicated in the head line above. They lay the foundation for a policy that will permit women to work to the greatest advantage when the call comes for them to enter industry in large numbers.*

Mr. C. E. Knoeppel, *founder and president of the firm of C. E. Knoeppel & Company, Consulting Engineers, served through the shop as molder, draftsman and designer in the plants of several representative manufacturing firms. Later he became an expert systematizer. After specializing on analytical work in factory management he was in the employ of a number of industrial establishments, and was associated with three firms of industrial engineers. This led to the founding of the organization he now heads.*

YOU may recall the questions published in INDUSTRIAL MANAGEMENT in January in regard to the entry of women into industry. They are as follows:

1. How are we going to find the immense army of women needed?
2. What basis shall we use for selecting women for industrial work?
3. What efforts shall we make to provide clean, wholesome living conditions?
4. What changes will we have to make to provide proper working conditions?
5. What social conditions will we have to provide?
6. What hours should women work and how about rest periods, fatigue and the like?
7. How will we arrange to subdivide and arrange the operations so that women can efficiently perform them?
8. How will we train women and who will do it?
9. What steps will be necessary to induce the full coöperation of:
    - (a) Labor unions?
    - (b) Organizations of women?
    - (c) Our government?
10. What steps should be taken to change and unify the state laws with reference to woman labor?
11. How shall we adjust and arrange the wages of women?
12. What will we do with reference to woman labor after the war?

These questions have to do with the location, selection and training of women; working, living and social conditions; the work to be done by women; hours, fatigue and wages; existing laws; coöperation of the labor unions, women's organizations and the government; and the post-bellum factor—all of which are essential considerations in any intelligent presentation of the subject.

The questionnaire attracted no little attention and many requests have already been made for the conclusions. The answers were both a revelation and a disappointment. A revelation, in that the general trend was altruistic, big-minded, clean and thoroughly American, and showing conclusively that *organized labor has nothing to fear from the manufacturing world on this question of women in industry.* A disappointment, in that there was evidence of lack of plan, no coördinated action and a lack of coöperation, so necessary in the successful use of women in our factories.

To place the results of this investigation in the most logical order, the subjects were arranged as follows:

A. The work to be performed by women.
B. Finding the women.
C. Selection of women.
D. Training women.
E. Wages, hours and fatigue.
F. Working conditions.
G. Living and social conditions.
H. State laws.
I. Cooperation of:
    1. Labor unions.
    2. Women's organizations.
    3. Government.
J. Post-bellum considerations.

Let us now consider each in order.

A. THE WORK TO BE PERFORMED BY WOMEN

It was clearly evident from the answers received that manufacturers had no well-defined views regarding the work women should be called upon to perform, nor where they would be placed if necessity forced them into employment. It was apparent, however, that this was the first point of attack, for how could we look for a person to do something which had not been defined or outlined as a task to be performed? We could not say, "Here is a job, let's find a woman to do it."

A study of the answers did disclose, however, the essentials to consider, which, if pieced together and coordinated would furnish a plan of action.

A few felt that it would be unnecessary to subdivide operations, first, because women had proven themselves more efficient than men and, second, because proper training and supervision would be all that would be necessary to secure productiveness from women. The concensus of opinion, however, was that work should be studied with the view to subdivision, in order that women might perform the lighter and less complex tasks and men the heavier and more complicated work—in other words, to determine the class of work in each shop or industry that women could both safely and efficiently perform.

To do this quickly and profitably, it was suggested that a planning department be organized in each plant, which could make scientific studies of the different kinds of work or operations, and in conjunction with the superintendent and department heads, classify the work women could do. As an excellent coöperative measure, it was also suggested that use be made of district factory inspectors or women physicians, or both, in determining what women could do, or better yet, *what they could not do.*

As part of the program, it was felt that the mechanical aids in factory work should receive careful attention. Hoists and conveyors should be utilized to eliminate unnecessary lifting and handling; jigs, tools and fixtures should be developed, looking toward making work simpler and easier to do; single-purpose machines, both semi-automatic and automatic, should be designed and constructed. It was also suggested that investigations should be made of laborious operations performed by men, with the view of developing labor-saving tools, and then use female labor.

It was also thought that, insofar as might be practical, machinery should be rearranged so that women could work in groups. Further, women should be given different things to do during the day, to avoid over-specialization and to relieve the monotony which inevitably follows when a person does the same thing day in and day out.

Men should set up the work excepting in cases where rigging the machinery is a comparatively simple and easy task. It was felt that a safe rule to follow in determining what women could do, would be:

(a) Use experienced men for difficult and complicated work.
(b) Use laborers for heavy manual work.
(c) Use women for light, simple or semi-complicated operation with men setting up the work.

For instance, one field where women could work to advantage would be tool making, a line which calls for the very qualifications women possess—neatness, accuracy, precision, dexterity and quickness.

To sum up an analysis of work, based on a consideration of the above fundamentals, would very quickly determine in each department, plant and industry, what women could and could not do. A list of permissible operations for women could then be worked up, by the government or under government direction, and industry generally advised as to the field for women, along the lines followed in England.

B. Finding the Women

After determining the nature of work in industry which women can perform with safety to their health and strength, the task becomes one of finding the women who are fitted to take up industrial occupations. Where are we to find them? How are we to obtain their consent to enter the factories?

Analysis of the answers revealed that there were a number of avenues of approach. In the first place, a great many felt that as we become more and more organized for war, the non-essential industries, wherein women were employed, could contribute not a little to the supply of female labor. Whether or not this will lead to much, depends to a large extent on what the non-essential industries are and what the government's attitude is likely to be toward the great question of "business as usual."

Unquestionably, many women could be recruited from the ranks of those known as household servants, for in this crisis we should do without servants. The childless married women could serve all of their time, and the married women whose families have grown up could serve part of their time. In the so-called idle and leisure class, many women could be found to assist as well as many unemployed women who would like to work.

There is also the large number of wives and sisters of soldiers who have gone to camp or to the front. A large number of women not directly engaged in agricultural pursuits in the rural districts could also be recruited. We are using colored men, why not colored women? Then there are many wealthy girls whose patriotism could be appealed to. But by far the largest number could be drawn from the families and friends of those already employed in factories. At any rate a review indicates that there will be plenty of women to draw from when they are needed.

The next point is how to induce them to enter industry. The concensus of opinion was that if wages for women are to be the same as paid men for the same work, if conditions are made attractive and such that women can work without injury to their health, there would be no question about getting them to respond should an appeal be generally made for them.

It was felt that appeals could be made through agencies such as:

Women's organizations, schools, Y. W. C. A.'s, Epworth Leagues, Catholic societies, churches, factory bulletins, moving pictures showing women at industrial work, industrial exhibits free to women and showing how factory work is done and what is produced, Departments of Labor—state and national, associations of manufacturers, editorial support in newspapers and magazines, advertising appeals similar to those for ship-workers and ordnance workers, magazine and newspaper articles, public lectures, campaigns putting before the women of America what the women of England have done.

It was felt by several that the basis of the appeal should be to so place the matter before women, as to insure against their losing caste by going into the shops, that it would not be degrading work but big, patriotic and a real help in this crisis.

A number thought that women could be recruited the same as men are employed, through making it known that women were wanted and engaging the best from those who applied for work.

It was felt by many that the Government should take the work in hand, make a census or house to house canvass and recruit in this manner and, if the case gets really critical, exercise the right of selective draft for both men and women for industrial work.

Still others were of the opinion that through women employment managers and the employment exchanges of the country, plenty of women could be located and induced to apply for work. One very good suggestion was to have the Government work through the National Chamber of Commerce, wherein labor, women and the manufacturers would have representation. Another suggestion was that a campaign like that of the Red Cross could be instituted.

C. Selection of Women Workers

Knowing the work that women can do in industry and having worked out plans for inducing them to apply for work, the next step is that of selection. This question seems easy of solution according to the answers received—simply match qualifications against requirements. In other words, the task is one of determining the character of work and selecting the type of woman who can do it, or, put in another way, find the women who can work and then train them.

Several suggest both physical and mental examinations with tests for deftness, strain, fatigue and skill.

Among the qualifications which should be considered, as taken from the answers are: Age, adaptability, past experience, type, nationality, education, physique, health, intelligence, strength, moral character, looks, cleanliness, social standing, general aptitude.

One suggested that women be tried at different tasks before determining what they might be best suited for; another that a list of the various kinds of work should be posted, showing the women the nature of the tasks done in the shops, and let them select the kind they feel they are best fitted for.

Several felt that it was a matter to be handled through women employment managers and women supervisors. It was also felt that after employment, close supervision for from four to six weeks should be made to see to it that requirements and qualifications did match. One very excellent idea was that women should be classified by local boards, not only with reference to physical and mental fitness but in regard to home demands as well, and that employers should requisition these boards, stating kind of work, location of plant, convenience for female labor, housing conditions and other important factors effecting women workers.

It was believed by several that teachers should not be used in industry unless absolutely necessary, as this would have a detrimental effect in educational work. It is further thought that some distinction should be made as between the family woman, the business woman and the scientific woman.

In many cases women could take up the same work as their fathers, brothers and husbands, because of the ability of the men to assist and instruct.

D. Training the Women

Many of the women will be totally unfamiliar with factory work or the operation and handling of machinery, so the matter of training becomes doubly important. It will be necessary to organize a system of competent instruction if the change to women employees is to be made rapidly and efficiently, and the heavy loss in production while they are learning is to be reduced to a minimum. To be prepared, the preliminary work of organizing a crew of instructors should be started as soon as it is decided to use women workers.

The instructors to be used should be selected from the fastest workers in the organization. The mistake, however, should not be made of thinking that any fast operator will make a good instructor. There are many people who are able to do things who cannot impart their knowledge to others, or explain logically how they accomplish their results, consequently they are useless as instructors.

The work of the instructors should be carefully studied—with a stop watch if necessary—the fastest method of performing the operation determined, and that method taught to all instructors.

When women are hired they should be immediately turned over to an instructor and the instructor should stay with them until they are performing the operation exactly as taught. The instructor may then leave, but should return at frequent intervals to watch the progress made. In no case should new employees be only partially instructed or allowed to choose their own way, for once a worker has learned to do a thing the wrong way at a fair speed it is doubly hard to make him give that way up for the right way.

Instructors should be selected for their ability to explain things clearly; for pleasing personality, tact, patience, sympathy and consideration for the rights of others; for ability in performing the tasks they are to teach, and wherever possible unusually masculine men should not be put in charge of instructing women.

One suggestion was that instructors be recruited from the women of a community who have shown executive ability. Another good plan would be to let women work part time as a step toward training women who could be used as forewomen. Instructions should be given first by men, then by the women who become most proficient.

E. Wages, Hours and Fatigue

The matter of wages, hours of work and fatigue, is most important in connection with utilization of woman labor. It can well be said that the success or failure of the movement depends to a great extent upon what we do with reference to those things.

The answers with reference to wages narrowed down to the following:

1. Determine standards, and pay according to performance.
2. Piece work, with minimum wage guaranteed.
3. Weekly wage for a time, and then piece work.

The principle "equal pay with men for equal work" was subscribed to by practically all who answered the questions. One replied "leave it to the women," feeling that they were amply able to take care of themselves.

Several felt that earnings in advance of those paid men should be offered to attract women workers and secure interest and coöperation, as for instance, have a minimum wage which exceeds the amount provided by state laws, or pay women 10 per cent. more than men receive.

Some were of the opinion that while women should receive the same as men if they produce the same, they should receive less if they do not produce as much, conversely more if they can exceed the production made by the men.

All through the answers, it was plain to be seen that the feeling was, *no exploitation of women.* One went so far as to urge that the Government take steps to prevent any possible exploitation in the unorganized industries.

Our review indicates quite clearly that organized labor has nothing to fear from the manufacturing world as regards women in industry.

In analyzing the questions as to hours, rest and fatigue, the conclusions were: 1. No night work; 2. no overtime; 3. no Sunday work; 4. half Saturday off; 5. an 8-hour day, some urging 54-hour week; 6. a rest period in the morning and in the afternoon, in addition to the lunch period, varying from 10 to 20 minutes; 7. experiments to determine rest periods and fatigue factors in work of a very fatiguing nature.

It was also felt that nurses or matrons should be employed to observe the condition of women and look for signs of strain, nerve tension and fatigue, in order that women may operate at maximum efficiency in a physical way. Several suggested that arrangements be made to have female physicians assist in this important matter.

F. Working Conditions

Another very important factor in connection with the utilization of woman labor is the matter of conditions under which they work. You may select the best of women and pay the best of wages, but if working conditions are not right the result is bound to be both discontent and dissatisfaction.

The shop is a second home, in which many hours are spent each day. If this thought is made the basis for improvement in working conditions, there will be a much better relationship between the women workers and the employers.

All workrooms should be generously lighted, which helps speed and accuracy.

In regard to ventilation, languor, headaches and a disinclination to work are found where the air is allowed to get stale. Fresh air should be admitted and bad air removed from rooms in such a manner as not to create drafts. Any ventilating system that accomplishes this will be satisfactory.

Room temperatures should be kept constant. The best temperature varies in accordance with the strenuousness of the labor performed in the room. With a little study of conditions the most satisfactory temperature can be determined, and there are any number of devices which will automatically keep the room at the temperature desired.

The question of position at work is especially important for women as their health and efficiency are largely dependent upon it. Wherever possible their work should be arranged so that they may be seated, and the chair or stool designed so that they will sit in an erect position. Where their labor requires that they stand a large part of the time, high-stools can be designed on which they may rest in a semi-sitting, semi-standing position. Special attention should be given to arranging their work about them so that everything needed is within easy reach. This not only adds to comfort but greatly speeds up the performance of the operation.

Labor-saving devices should be installed wherever possible, to eliminate lifting and handling by women. Safety appliances should be given the most careful attention and rigid "safety first" rules maintained.

Women should first start on the lighter tasks and as they become proficient take up heavier ones if physically able to do so.

Under no consideration should women be placed at what might be called dangerous occupations, or work where they are likely to be poisoned or suffer bodily injuries through explosions. They should not be placed in departments where gas fumes or dust would prove detrimental to their health, nor should they be subjected to intense heat or intense cold.

In introducing woman labor, new buildings or new departments or new floors should be added, if possible. Women should be segregated if this can be done, either by new buildings or rearrangement of departments or machines. At first men would have to be used as foremen but later forewomen could be used.

There should be no smoking by men when men and women are working together; it is well to allow women the right to sing as they work. There should be provision for emergency illness with a nurse in charge if no hospital is a part of the plant.

As work is bound to get monotonous if the same thing is done all the time, arrange so far as possible to change the tasks during the day so as to furnish some variety, a variety that will keep a woman standing at one time and sitting at another.

After lunch and during recreation periods, women should be allowed to relax completely and enjoy themselves; this course will be found to keep them in the best mental and physical condition. A music room with piano or victrola for dancing will be found a most excellent provision. Calisthenics during one of the rest periods will be well worth the effort as all will appreciate the value of 10 to 15 minutes of setting-up exercises daily. A library with books and magazines will be used to advantage by those who do not care to dance, and rest rooms by those who would rather lounge.

Separate entrances for men and women should be provided, or better yet, men and women should arrive and leave at different hours, so that there will be no intermingling that is often so objectionable to women.

Working clothing of women should be standardized. Overalls can be used or waists and aprons. Caps should be worn for protection of the hair. Whatever is used should be uniform, neat and kept clean. If all are dressed alike, there will be less rivalry as to dress and less in the way of comments by the women regarding the matter of dressing.

A matron should be employed to see to it that factory laws are lived up to; watch for any violation of the "safety first" rules, and also look after the general health of the women. If possible, this matron should be a nurse.

Provision should be made for properly policing the streets when women enter and leave the works, to guard against women being molested by rowdies and loafers, so often observed on our street corners in industrial sections.

It is recommended that 45 minutes be allowed for lunch, to give the women ample time for eating as well as for recreation.

The providing of healthful working conditions while important where men are concerned, is doubly important where women are at work. If women are willing to step in and fill the places the men have left vacant in industry, it is only right that industry should surround them with conditions conducive to their health and well-being.

With reference to sex complications Rheta Childe Door has this to say in the *New York Evening Mail:*

> Let us be quite frank and translate "complications," as most people will employ the word in sex complications. Should we have that bogie to deal with if American women took over the civilian tasks now performed by enlisted men?
>
> The highest English command raised that question when Florence Nightingale took her first heroic little band of women nurses out to the horrors of the Crimean campaign, and that little band of heroic women answered the question for all their sisters who were to come after them.
>
> Have any "complications" arisen from the thousands of Red Cross nurses who have volunteered for the field during this war?
>
> Have the Y. M. C. A. and the Y. W. C. A. women "complicated" matters for any army? They have not, and neither would any other service of women at home or abroad.

(*To be continued*)

The Multifamily House for Industrial Housing

By Henry Atterbury Smith

THE problem of providing homes for working men in the vicinity of industrial centers has been aggravated by the conditions of war, and difficulties with which industrial managers were formerly unfamiliar are now demanding much serious study. What is the best type of building to erect for industrial housing? What are the relative costs and expenses of maintenance of various types of homes suitable for industrial communities?

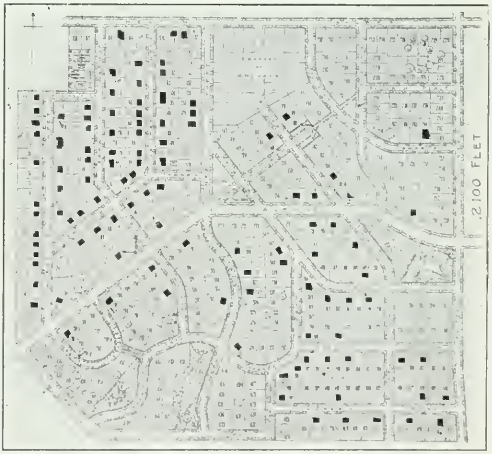


FIG. 1. USUAL DESIGN FOR IMPROVING BUILDING SITES

Most of us, when we think of workingmen's houses, picture a cottage, for it is the simplest form of habitation. And, no doubt, it is the best type of structure in which to establish a home for the development of character and the raising of a family. But from the economic viewpoint its cost and maintenance charges stand in the day, so comparatively little is being done to-day to fill the demand for additional housing by developing cottage communities.

In studying housing plans and investigating what has been done in various localities, it is evident that certain sections favor one kind of development, while another was preferred in some other place. It has been found that homes that were indifferently glanced at and assumed to be single residences were actually double houses, or even gradruple houses. Sometimes it was discovered that structures evidently intended to house but one family held two, or three, or more.

This article is addressed to the matters of housing efficiency and economy, not only in the original cost and maintenance charges, but also in the expenditure of effort on the part of the occupants. It is addressed to those who realize that there must be all sorts of homes in any given community to gratify individual tastes, necessities, varying incomes and the like. There have been many housing schemes launched for individual houses or, so-called, semi-detached houses. I purpose to compare one of these with the broad plan for the multifamily house.

Figure 1 shows a plot of ground substantially square. It is within easy walking distance of an immense and growing industry and has first-class trolley connection with a large town. The plot contains 100 acres of land and costs $30,000. To prepare it for the usual cottage development an additional sum of $180,000 was spent for grading streets, putting in sidewalks and sewers and for similar work. The whole plottage was upheaved and graded at the outset for the building of 430 houses. (As a matter of fact nearly all of our suburbs are cut up in just this fashion, and many of them are never more than from one-quarter to one-half utilized.) Only 107 houses have been built out of the projected 430.

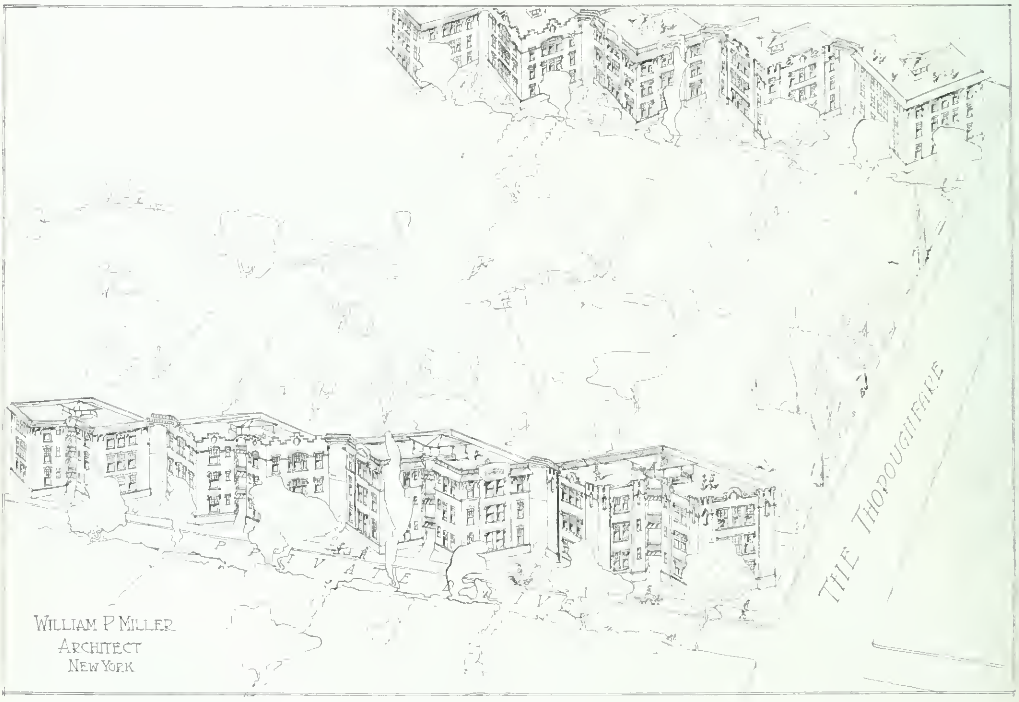


FIG. 2. IMPROVED PLAN FOR LAYING OUT BUILDING SITE AND ERECTING MULTI-FAMILY HOUSES

THE MULTIFAMILY HOUSE

Now let us compare another method of development —that of the multifamily house. The plan that I wish to present for consideration is unlike the usual multifamily scheme, in that the land is not to be crowded with a single additional family. That is, there is allowed the same amount of ground space, light and air for each individual as is provided by the cottage scheme. Refer to Figure 2, which shows such a project on a plot of land of the same general dimensions as the one given in Figure 1.

Observe that entirely aside from the cost of preparing the site for the buildings and all other development charges, the landscape does not have to be ruined by "developing." Four rows of multifamily houses are planned for, occupying only a small amount of ground area for the structures themselves, and leaving all the remaining land, trees, meadow, hills or lakes, if there are any, just as nature made them. If the site has any advantages, and if the location is a suitable one, such surroundings ought to be attractive. If desired the landscape architect can add to the surroundings by laying out gardens in the fertile spots, playgrounds where they are desired, and fields for games and recreations.

The houses, supplied with heat and hot water from a central plant, and equipped with practical, economic and labor-saving devices, give the occupants extra time for industry or leisure for gardening, games or other interests.

It is obvious that a plot need not be square to be adapted to this type. It may be urged that a home of this kind cannot be purchased by the occupant. This is true. But the buildings must be owned by a company of some kind, and stock in that company can be sold to the persons who dwell in the houses.

Mastering Power Production-VI

Thorough Training of Workers Precedes Successful Operation

By Walter N. Polakov

In the opening paragraph the author declares the principle of self-government in industry, emphasizing that the power departments of industrial organizations should have their own staffs of specialists to determine and direct specific functions. He then turns to the importance of establishing standard practice which, however, must be progressive, not ultimate, and must be modified as rapidly as conditions change. To carry this standard practice into the habit stage instructors must train the employees.

Mr. Walter N. Polakov *is a consulting engineer specializing in the management of power plants. He was educated in Russia and Germany, held a position of shop superintendent and chief engineer in Russia and was also instructor and consulting engineer to the Naval Academy at Baku. After coming to this country, and prior to taking up his own practice, he was consulting engineer to the Board of Estimate and Apportionment of New York City, consulting engineer for the Penn Central Light & Power Company and Superintendent of Power of the New York, New Haven & Hartford Railroad Company.*

ANY change in the economic life of the country or the world does of necessity readjust the social relations of productive forces. These new relations, reshaped primarily to meet the new conditions and requirements of the material life, gradually change the habits and mode of thinking people and finally formulate new ideals. Roman domination of the ancient world eradicated distinctions between small, oppressed nationalities, substituting therefor a new ideal of brotherly love for the old lust for domination.

When the efficiency of wage earners compared favorably with slave labor, the new relation found its expression in the formula "Liberty, Fraternity, Equality." When again, the socially irresponsible control of production failed to meet the demands for higher production *industrial democracy* became the new ideal. No sooner does the old order of things give way to the new, than the old mode of production has already developed all its possibilities, and the new way appears clearly; leading away from the vicious circle of contradictions.

The present great conflict between autocracy and democracy has more than political significance. The principle of "Government for the people and by the people" awaits its application within the realm of economic relations, since it is more and more generally conceived that the ignorant and irresponsible control of production causes waste and leads to destruction. The alleged supremacy of autocratic government, either of nations or of industries, is a fallacy created by the confusion of parts with the whole. The relative advantages of Teutonic imperialism is in the recognition and thorough application of *the principle of coördination of action and strict accountability for results*, not in the principle of arbitrary absolutism. Whenever the people themselves exercise the right of judging the results and actually choose their own leaders, there is obviously no opportunity to substitute the ideal of oppression for this of mutual benefit.

What seems to be correct in respect to nations is equally true in the industries. The success of great industrial leaders and managers was in the final count due to the adoption of superior forms of organization, wherein the thorough knowledge of facts takes the place of ignorance, and coöperation supersedes competition.

It is obvious that without a thorough knowledge of facts pertaining to all functions involved in production, the possibilities may not be fully recognized. Moreover, full advantage of facilities, materials and knowledge cannot be attained unless there is a full coöperation striving at the realization of the highest aim. Hence emphasis was laid in the foregoing installments of this series on the importance of a full knowledge of the elements entering into the problem of power production.

Autonomous Coöperation

To carry out such a program a fitting managerial mechanism must be developed. Taylor's functional foremanship offered a logical and promising step in this direction, yet its intrinsic limitations retarded its wide application. Managerial functions, centering in the planning department, gave a strong autocratic smack to its *ukases*. The democratic spirit of coöperation was sacrificed to that of oligarchy by official bossdom; the routine of administrative control became by necessity complicated, perhaps cumbersome, and finally the success or failure of the enterprise, so organized, hinged on the spirit of the man at the top. (But so it is with the Kaiser. Were he animated with the ideals of humanity, Germanic thoroughness would perhaps be bent on beneficial constructive work, instead of destruction.) Such is the inevitable trap into which falls the individualistic cult of "hero," of "leader" or of "superman."

"Ganttizm," if I am permitted to introduce this term to denote the new conception in industrial philosophy, conceives the wholesomeness of autonomous self-government of shops. The success of each worker contributes to the success of the whole establishment, since the lowering of quantity or quality of the product by even one affects the rest unfavorably.

The writer has advocated for many years the importance of recognizing the autonomy of the power department in industrial organizations as well as in public utilities, and it should be obvious to any unprejudiced mind that no general planning department, however perfectly organized and smoothly running, still less any old-type general management, is capable of wisely directing the peculiar functions of the power department unless it has on its staff power specialists to devise, direct and supervise the specific functions. If this is so, then the removing of such specialists from close, living contact with the department they are to direct and dumping them into an office whose functions are specific and distinct, is devoid of practical advantages. The close coöperation between the production and power department, or between the power plant and the other departments of a public utility, is of great importance both for the purpose of ascertaining the extent of demands, regulating peaks, etc., and for securing materials as well as coördinating other functions of mutual importance.

The Managerial Task

Mr. J. P. Frey in his *critique* of the Taylor system of management said: "It is unscientific because it has failed adequately to understand the human factor and the spirit of our American institutions, for it makes of one man a task maker and a taskmaster without consent of the other."

The government in a plant should be like government in a state, *with the consent of the governed.* Yet, if political self government is acquired by ignorant people who fail to set a wise policy, who are devoid of a far-sighted program and are prompted in their action by a desire to get immediate advantages without thorough consideration of ultimate results, such people fall an easy prey of a neighboring state if the latter happens to be strongly organized and aggressively inclined. Similarly, in case of an industrial establishment, self-government or management by consent should be preceded by broad and thorough educational work, to enlighten those actively engaged in production on matter contributing to the fundamental success of the establishment and ultimate benefit of the community.

In the preceding installment, the task was defined as *doing the work in the best devised manner* as opposed to the old conception of a task as the request to accomplish the most work. Taylor himself admitted that "the tasks were all purposely made so severe that not more than one out of five could keep up." Opposed to this our tasks are set so that anyone, unless he is physically or mentally disqualified for the work, can accomplish his task with comparative ease. In the power house, obviously, the quality means vastly more than the quantity of the work, hence, the paramount function of management is the training of employees not only in proper methods of work and in forming better habits, but also in teaching scientific rudiments and principles, a clear understanding of which is so essential for intelligently performing work. It is, therefore, the task of the management to offer the employee an opportunity to do the kind of work for which he has inclination and is fitted, to provide means and surroundings that facilitate the work and assure the possibility of good results and, finally, to assume full responsibility for seeing that the work is properly performed. In practice it means:

1. Helping employees to acquire correct and useful knowledge.
2. Helping employees to cultivate the habit of doing good work.
3. Rewarding meritorious work.

Putting Knowledge In Form to Use

To fulfill these obligations toward the men and the industry, the first problem is to render all the knowledge of facts previously studied into a readily available form. The mere tabulation of data gathered during tests and experiments is obviously unavailing for those whose duty it is to do the work. The facts, therefore, should be boiled down to a set of easily understood rules and presented either in the form of a written instruction or modified into graphs, slide rules, semi-automatic indicators, etc. For instance, when it is definitely determined what is the best rate of driving the boilers the dial of an instrument showing the rate of steam flow or boiler feed should be provided with plain markings indicating what number of boilers should share the load; then extra boilers may be banked or put in line as the case may be, without any further guess, reference, or calculation whatever.

Again, if a relation between the rate of firing, necessary ash pit pressure and draft in the furnace and at the uptake is established from study tests, a stoker engine tachometer may be provided with auxiliary dials showing for any rate of driving the required furnace conditions. The same arrangement can obviously be made on the steam flow meter dial of individual boilers, as the rate of firing under proper conditions is in a definite relation to the evaporation—hence each rate of steam flow calls for certain definite furnace conditions to attain the best economy. Less direct, but not less helpful than such semi-automatic instructions, are diagrams and slide rules, the use of which is readily understood by operators. For example, a plant contains three turbines of different water rates. With every change of load the question arises how the total load should be distributed among the units to consume the least steam per k.w.h., and what unit to have as reserve capacity to take-up fluctuations. A special three-disc slide rule can easily be prepared to help the opera-

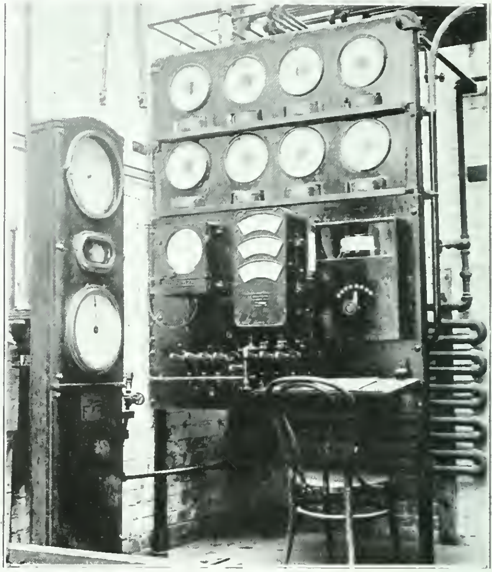


FIG. 17. INSTRUMENT BOARD

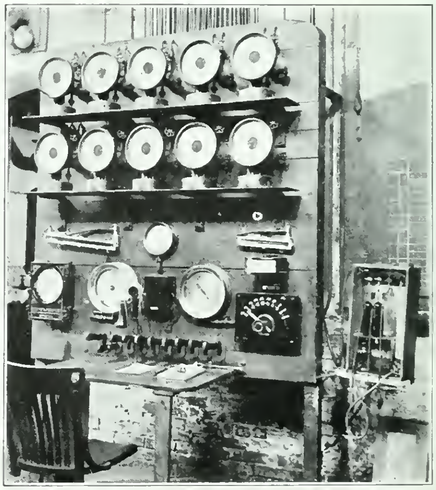


FIG. 18. RECORDING INSTRUMENTS FOR ENGINEER

tor to almost instantly decide what combination assures best steam economy compatible with the required safety provisions. See Figure 19 herewith.

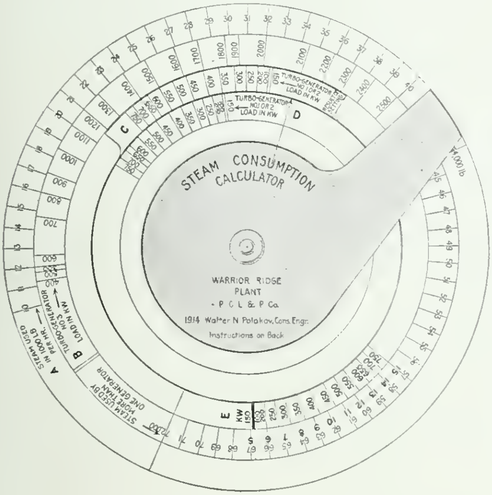

STEAM CONSUMPTION CALCULATOR
WARRIOR RIDGE PLANT
- P C L & P Co
1914 Walter N Polakov, Cons. Engr.
Instructions on Back
A STEAM USED IN 1000 LB PER HR.
B TURBO-GENERATOR NO 3 LOAD IN KW
C
D
TURBO-GENERATOR NO 1 OR 2 LOAD IN KW
TURBO-GENERATOR NO 1 OR 2 LOAD IN KW
RESULT OF SETTING
E KW
STEAM USED BY MORE THAN ONE GENERATOR
14,000 lb
72,000

FIG. 19. THREE-DISC SLIDE RULE FOR STEAM CONSUMPTION

Presenting Definite Instructions

The simplest form for presenting a definite instruction is a written instruction card describing in clear concise paragraphs the practice and sequence of jobs to be performed. See Figures 20, 21 and 22.

Whatever the form or means of issuing the instructions to the operators, it must be so *clear* as to prevent misunderstanding; it must be *complete* so that no detail that may possibly influence the result is omitted. The preparation of a set of such instructions should be made a distinct duty, by the management delegating for such work either one man or a group of specialists. Yet it is obvious that the work of crystalizing the best knowledge available could never be done without the closest possible coöperation with the entire force of employees.

The American Society of Mechanical Engineers a few years ago, reporting on scientific management, used the expression "transfer of skill." The deep meaning of this term is in the suggestion of transfering it in both directions—from universal labor to coöperative labor, from scientist to worker, and the reverse. While the theory is modified by experience, the experience is peeled off from the crust of old traditions, habits, fallacies and customs of the trade, frequently inherited from times when means and conditions of work were vastly different than they are today. This process of standardization of methods, as opposed to the old and recognized standardization of mechanical parts, is comparatively a new conception and care shall be taken to avoid an illusion that a standard method is something permanent and unalterable.

A method is a mode of action; it is a living thing and as such is subject to constant development and modification. With each change in surrounding conditions, appliances and materials used, new discoveries made, etc., the methods of work or operation should be revised and modernized. As soon as this principle is lost sight of, the whole organization becomes a dead system and a plant carrying it out to the letter is like Rip Van Winkle going to sleep while progress passes by. In this light the plant office is the custodian of all available knowledge, the study-man in coöperation with the entire force keeps vigilant watch over every possible point of progress, and modifies practice as and when conditions and requirements change.

With the preparation of clear and complete instructions, the work of standardizing is not finished—it only begins at that moment. To assure the proper use of knowledge and the living up to prepared instructions, the training of employees is most essential.

The Instructors

The plan of thorough instruction and training for firemen, engineers and other employees simplifies the problem of securing power-house help and, in fact, solves the problem by developing the skill, intelligence and efficiency of the employee to suit the highest requirements for each position.

Any management that neglects to provide proper training for its employees, clearly fails to fulfill its duty. The means for such a provision, however, are by necessity very different depending on the size of the plant. While in a large central station, the plant office acting as custodian of information has delegated permanent instructors with each shift in boiler, pump, turbine, and high tension rooms, on the switchboard and with the repair gang, a smaller plant in a mill or isolated building may be satisfactorily served by a single man acting as instructor and supervisor. Between these two extremes a number of variations are possible. In every case, however, the main point should be clearly borne in mind; that *the expense for such service is insignificant in comparison with the savings resulting from the work of a well trained crew.* In fact the savings usually are so large in proportion that the expenses, even for high priced specialists, are covered many times over.

In the case of large plants, the instructors assigned to each shift may be compared with what Taylor called "work bosses" and should have the qualifications expected of them. The result of their work can be accurately measured by the number of men under their care who learn successfully and acquire the habit of performing work up to the standard.

Inasmuch as the least skilled and most backward men require more help from instructors to bring the level of efficiency up to the standard, it has been found beneficial to stimulate this spirit of helpfulness by a special reward to the instructors. To that end, the instructor receives, over and above his salary, an extra remuneration for each man who learns to perform the work with the predetermined degree of efficiency, and a double reward for every man under his instructions on the days when *all* the men live up to their tasks.

The value of a careful, systematic and prolonged training of the employees cannot be over-emphasized. The most difficult part of this work is breaking old habits. The restraint from habitual actions often makes the employee nervous even if he is thoroughly convinced of the advantages of the new method. If, however, the new way appears to him as an unreasonable fancy of his superior, who failed to make it clear to him that the change is reasonable and to mutual advantage, the strain on his nerves caused both by suspicion as to the outcome and concentration of mind on unfamiliar actions may take the form of concealed sarcasm or even open hostility.

The functions of an instructor are, therefore, at once those of an expert and a tactful human administrator. The demoralization that may be caused by lack of either is serious and far-reaching, and it is commonly known, that when perfectly good orders issued by the management fail to produce the expected results, the cause can almost invariably be traced to the fact that it was expected that the new order would take place by itself. The good old saying that the best way to doom a thing to failure is to give it "a fair trial" is always true whenever a capable man is not made responsible for its success.

Whereas these considerations are equally applicable to training workmen in any line of work, the power plant presents a number of special problems in connection with education. Sometimes the most rudimentary knowledge of chemistry and the laws of physics is sufficient, as for firemen, while in other cases more profound insight into the scientific basis of things is essential, as sometimes with electricians. Our "engineering letters" form the foundation for subsequent discussions, lectures and other phases of an educational campaign.

It would be manifestly erroneous to think that the job of an instructor is a temporary one. It is as permanent as the plant itself, inasmuch as men, supplies, conditions and rerequirements gradually change: new investigations must be carried out, and to meet the changing circumstances the management must convey the revised information to the men, constantly making available to them the gain in knowledge.

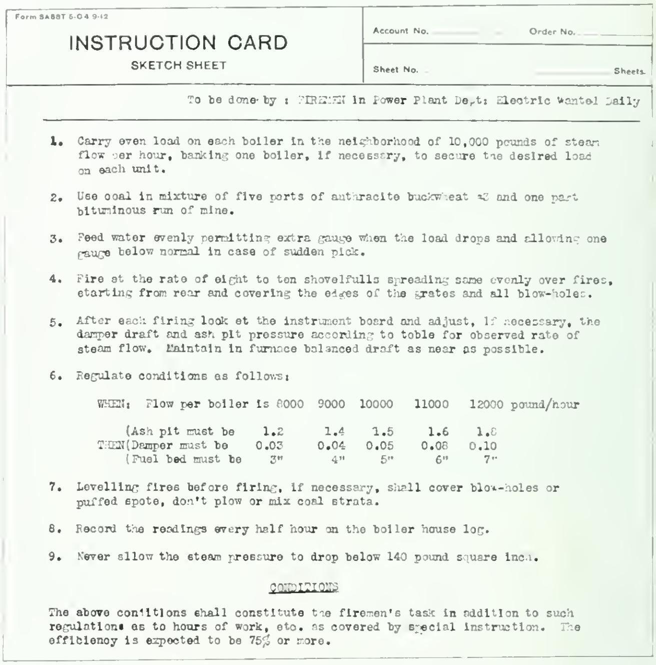
It would be utterly wrong, however, to assume that a mere preparation and posting of instruction cards is capable of accomplishing anything more than creating confusion and sometimes dissatisfaction.

In a public-utility plant a coal passer was started rather hastily on a new method of work per instruction card. The following quotation from a report made on the subject is self-explanatory:

> "180,000 pounds of coal were handled by 4 men in 24 hours. Two men working together 12 hours each day and passing 45,000 pounds each, could not stand the work: it was too hard. This was because the shovel had a short handle and they had to bend too low; the shovel held only 16 pounds of coal instead of 21.5 pounds, causing the workman to bend too many times per ton; the wheelbarrow held only 250 pounds, causing too many trips. When the man was given the right kind of a shovel and a wheelbarrow holding 400 pounds, yet throwing less weight on his arms when lifted with the load, he handled 65,000 pounds in 8 hours (instead of 45,000 pounds in 12 hours), and found his job much easier than before. This man, however, was left to himself before the new way of doing the work formed a habit with him. In a short time he came to us complaining of fatigue and refusing to continue the work. We started to watch him again, and the trouble was clear.
>
> "He did not observe the instruction card. This card ordered rest every so often, for so many minutes, sitting. Instead the man worked much longer at a stretch, thinking that longer rest afterward would refresh him better, and when resting he spent the time standing and chatting to a fellow worker and not sitting as prescribed. That was enough to cause fatigue. The rest of the gang of coal passers at Warrior Ridge were finally put on the task in the proper manner, but no complaint has since been heard, and their health and spirits are markedly improved."

Education vs. Training

When more than a year ago, through this magazine, I called the attention of the public to the impending dangers of fuel shortage and outlined the general plan of preventive work, few appreciated the gravity of the issue. Since then every prediction has come true and most of the recommended steps have been taken through the legislation or by the fuel administration.



Form SA88T 5-04 9-12

INSTRUCTION CARD
SKETCH SHEET

Account No. Order No.
Sheet No. Sheets

To be done by : FIREMEN in Power Plant Dept: Electric Wantel Daily

1. Carry even load on each boiler in the neighborhood of 10,000 pounds of steam flow per hour, banking one boiler, if necessary, to secure the desired load on each unit.

2. Use coal in mixture of five parts of anthracite buckwheat #2 and one part bituminous run of mine.

3. Feed water evenly permitting extra gauge when the load drops and allowing one gauge below normal in case of sudden pick.

4. Fire at the rate of eight to ten shovelfulls spreading same evenly over fires, starting from rear and covering the edges of the grates and all blow-holes.

5. After each firing look at the instrument board and adjust, if necessary, the damper draft and ash pit pressure according to toble for observed rate of steam flow. Maintain in furnace balanced draft as near as possible.

6. Regulate conditions as follows:

WHEN: Flow per boiler is	8000	9000	10000	11000	12000 pound/hour
(Ash pit must be	1.2	1.4	1.5	1.6	1.8
THEN(Damper must be	0.03	0.04	0.05	0.08	0.10
(Fuel bed must be	3"	4"	5"	6"	7"

7. Levelling fires before firing, if necessary, shall cover blow-holes or puffed spots, don't plow or mix coal strata.

8. Record the readings every half hour on the boiler house log.

9. Never allow the steam pressure to drop below 140 pound square inch.

CONDITIONS

The above conditions shall constitute the firemen's task in addition to such regulations as to hours of work, etc. as covered by special instruction. The efficiency is expected to be 75% or more.

FIG. 20. INSTRUCTION CARD FOR FIREMEN

The educational campaign, however, aimed at the necessity of generalizing the endless variety of plant conditions and equipment, has value not as a method of conveying useful information and knowledge but in pointing out the deadly sins committed in the daily operation of power plants. The Assistant Fuel Administrator for Ohio summarizes those of wasteful firing, as follows:

(a) Firing too heavily.
(b) Firing at too long intervals.
(c) Not covering grates evenly.
(d) Not breaking lumps of coal.
(e) Checking draft by ash-pit doors, instead of by stack damper.
(f) Firing both doors at once and not alternately.

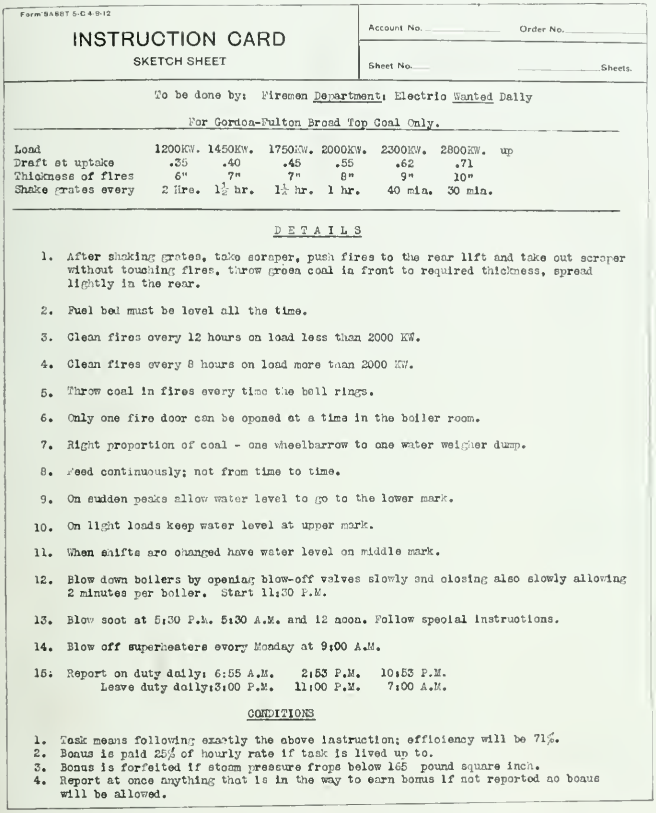
For these conditions he says the fireman is responsible. Then he continues: "Improper conditions of draft with respect to the load and fuel conditions are:

(a) Too little draft.
(b) Too much draft.
(c) Failure to keep the draft and the fuel thickness in proper relation.

For these conditions, Mr. Leach justly blames the plant owner "for not supplying the engineer with the necessary instruments for regulating these conditions." But why this discrimination? Does the fireman know what is the proper thickness of fuel bed, etc., etc.?

At the annual meeting of the American Society of Mechanical Engineers in 1917, I summarized the shortcomings of generalized instructions failing to take due cognizance of individual cases thus:

"Teaching efficiency (of power operation) by correspondence will accomplish little good. Endless variety of equipment, grades of fuel available, personality of men, nature of load, climatic conditions, etc., make the preparation of 'simple instruction sheets for engineers and firemen' impossible, and if same are made they are so general as to be useless. No instruction of real value could be given unless examination of the plant was made. Keeping records, logs, etc., necessitates instrument equipment and measuring devices. All of this is good only when the data are used and interpreted by a trained man and this must be done continually. If the regular employees failed to secure high efficiency, it is not because of the lack of 'circularized education,' but chiefly on account of, (1) lack of time to carry on investigations and tests, (2) absence of instruments, facilities and encouragement, (3) lack of experience in this highly specialized line of research work. *The education, therefore, should begin with owners and managers, and only end with the firemen.* Any half-measure with good intentions, falling short of accomplishing valuable results are dangerous as they chloroform the public conscience creating a belief as if something real is being done while there is little behind the words making all content that 'all is well.'"



Form 5A5BT 5-C 4-9-12

INSTRUCTION CARD
SKETCH SHEET

Account No. _____ Order No. _____
Sheet No. _____ _____ Sheets.

To be done by: Firemen Department: Electric Wanted Daily

For Gordoa-Fulton Broad Top Coal Only.

Load	1200KW.	1450KW.	1750KW.	2000KW.	2300KW.	2800KW. up
Draft at uptake	.35	.40	.45	.55	.62	.71
Thickness of fires	6"	7"	7"	8"	9"	10"
Shake grates every	2 Hrs.	1½ hr.	1¼ hr.	1 hr.	40 min.	30 min.

DETAILS

1. After shaking grates, take scraper, push fires to the rear lift and take out scraper without touching fires, throw green coal in front to required thickness, spread lightly in the rear.
2. Fuel bed must be level all the time.
3. Clean fires every 12 hours on load less than 2000 KW.
4. Clean fires every 8 hours on load more than 2000 KW.
5. Throw coal in fires every time the bell rings.
6. Only one fire door can be opened at a time in the boiler room.
7. Right proportion of coal - one wheelbarrow to one water weigher dump.
8. Feed continuously; not from time to time.
9. On sudden peaks allow water level to go to the lower mark.
10. On light loads keep water level at upper mark.
11. When shifts are changed have water level on middle mark.
12. Blow down boilers by opening blow-off valves slowly and closing also slowly allowing 2 minutes per boiler. Start 11:30 P.M.
13. Blow soot at 5:30 P.M. 5:30 A.M. and 12 noon. Follow special instructions.
14. Blow off superheaters every Monday at 9:00 A.M.
15. Report on duty daily: 6:55 A.M. 2:53 P.M. 10:53 P.M.
    Leave duty daily: 3:00 P.M. 11:00 P.M. 7:00 A.M.

CONDITIONS

1. Task means following exactly the above instruction; efficiency will be 71%.
2. Bonus is paid 25% of hourly rate if task is lived up to.
3. Bonus is forfeited if steam pressure drops below 165 pound square inch.
4. Report at once anything that is in the way to earn bonus if not reported no bonus will be allowed.

FIG. 21. INSTRUCTION CARD FOR FIREMEN ON SPECIAL GRADE OF COAL

A line of demarkation must be very clearly drawn between the general educational campaign and the course of training for employees. The first precedes the second as far as management is concerned, *i. e.*, realization of the short-comings of the practice in vogue leads to the standardization of methods and training for the accomplishment of the task. With power-plant employees the course is usually reversed, namely, the instructions given during the period of training arouses their interest to the more general subject and the knowledge of how to do the work brings questions as to why this is the right method, which, as a rule, can be answered only through a study of the fundamental principles of the science involved.

When this stage is reached two things become apparent—work loses its monotony because the processes occurring are an open book, and conditions are adjusted much in the same spirit as in a ball game tactics are changed to increase the score. As a consequence of this aroused interest in the work a material improvement in service, efficiency and economy follows.

TRAINING FIREMEN

No man without thorough and prolonged training can acquire the new habits, and it is really the habit of work and the habit of the new way of thinking that must be aimed at in this work. We may know the truth, we may be convinced, yet, if we are not in the habit of practicing it all the wisdom and truth is of no avail. It is universally conceded that the good results obtained during boiler tests are never, or only seldom, duplicated in average every day practice. Yet if the conditions of load and service during the test were normal working requirements, there is no other reason for results falling short but the failure of the regular crew to carry on the work the way the experimenters did. The reasons for this failure may be any one of many: lack of means, knowledge, incentive, etc. It is quite common to read in various reports on boiler tests statements like those below:

"A different fireman was on duty. He fired the boilers and cleaned the fires in a different and apparently more efficient manner than the first fireman." Again in another report, we read, "The helpers do not realize the importance of coaling quickly and closing doors and it takes them longer to coal than the firemen . . ."

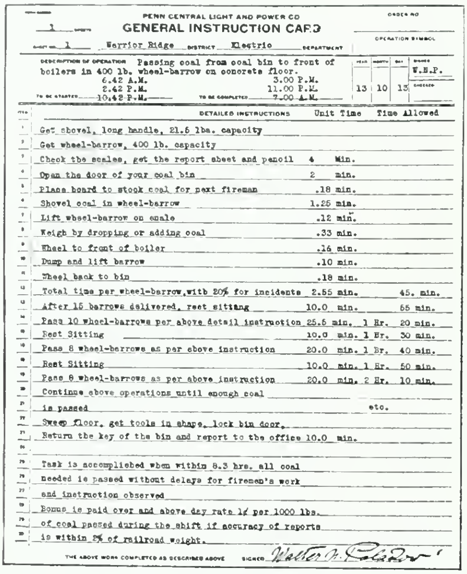
It is evident that the change of method will be followed by the change of result. The best result may be secured only if the best method is pursued by all firemen, and this obviously cannot be accomplished without training. Ordinarily firemen receive no training, merely a few words of instruction, while the helpers do not get any training other than the personal observation of the routine work done by the others. Such a process is naturally the longest, and the mental inequalities of different men make it, in some cases, still longer. Meanwhile fuel is liberally wasted by men of inferior experience.

An abstract from a report of the mechanical superintendent on the progress of such work in a mill plant is illuminating:

> After considerable investigation and deliberation, we decided to obtain a specialist to consult with us regarding the most approved and scientific methods of boiler room practice. The work was started in January.
>
> The first thing we had to tackle was to find out what causes poor or good economy. Our coal and water records for the past years, when analyzed, brought out two facts:
>
> 1. That some firemen obtained higher efficiency than others.

2 That efficiency obtained during tests was much higher than that secured during every day operation.

It is a foregone conclusion that no two firemen fire alike, yet there can be only one best method. To discover this best method, we had first to install such additional instruments as would show the observer every change of condition and its effect on the results; second, to get an observer or study man who could devote all his attention to the problem. Such men are not to be found ready made unless you pay an exceptionally high price. Our course was, therefore, to develop one with the help of our advisor. We selected for this purpose a young engineer in our organization whom we made power supervisor, his duties consisting in addition to the aforesaid study work, the training of firemen and coal passers so that they may become proficient enough and accomplish the standard task. It was also his duty to keep records, obtain fuel analyses, make daily computations of boiler and grate efficiency, make charts showing in graphical form the weekly amount of coal burned, efficiency, cost of 1,000 pounds of steam, etc.


PENN CENTRAL LIGHT AND POWER CO

GENERAL INSTRUCTION CARD

ORDER NO

1

OPERATION SYMBOL

1 Warrior Ridge DISTRICT Electric DEPARTMENT

DESCRIPTION OF OPERATION Passing coal from coal bin to front of boilers in 400 lb. wheel-barrow on concrete floor.

TO BE STARTED 6.42 A.M. / 2.42 P.M. / 10.42 P.M. TO BE COMPLETED 3.00 P.M. / 11.00 P.M. / 7.00 A.M.

13 10 15 W.N.P.

CHECKED

DETAILED INSTRUCTIONS	Unit Time	Time Allowed
Get shovel, long handle, 21.5 lbs. capacity		
Get wheel-barrow, 400 lb. capacity		
Check the scales, get the report sheet and pencil	4 Min.	
Open the door of your coal bin	2 min.	
Place board to stock coal for next fireman	.18 min.	
Shovel coal in wheel-barrow	1.25 min.	
Lift wheel-barrow on scale	.12 min.	
Weigh by dropping or adding coal	.33 min.	
Wheel to front of boiler	.16 min.	
Dump and lift barrow	.10 min.	
Wheel back to bin	.18 min.	
Total time per wheel-barrow, with 20% for incidents	2.55 min.	45. min.
After 15 barrows delivered, rest sitting	10.0 min.	55 min.
Pass 10 wheel-barrows per above detail instruction	25.5 min.	1 Hr. 20 min.
Rest Sitting	10.0 min.	1 Hr. 30 min.
Pass 8 wheel-barrows as per above instruction	20.0 min.	1 Hr. 40 min.
Rest Sitting	10.0 min.	1 Hr. 50 min.
Pass 8 wheel-barrows as per above instruction	20.0 min.	2 Hr. 10 min.
Continue above operations until enough coal		
is passed		etc.
Sweep floor, get tools in shape, lock bin door.		
Return the key of the bin and report to the office	10.0 min.	
Task is accomplished when within 8.3 hrs. all coal		
needed is passed without delays for firemen's work		
and instruction observed		
Bonus is paid over and above day rate 1¢ per 1000 lbs.		
of coal passed during the shift if accuracy of reports		
is within 2% of railroad weight.		

THE ABOVE WORK COMPLETED AS DESCRIBED ABOVE SIGNED Walter N. Polakov

FIG. 22. GENERAL INSTRUCTIONS TO FIREMEN

Instructions can neither be transmitted to the men nor made use of, unless the plant is provided with the necessary facilities to observe the inner workings of the processes the men are to control. Much has been said and written about the necessity of various boiler room instruments and sarcastic comparisons often drawn between the elaborate equipment of switchboard panels and the boilers equipped with water gages. In fact there has been so much said about the necessity of having various boiler room instruments that many plants have already succumbed to the tempting talk of salesmen and have installed a variety of recording and indicating devices, but failed to provide for training in the proper use and interpretation of them. These then became a dead investment in a vast number of plants and serve no other purpose than to increase the overhead charges. The situation is entirely different in plants where care is taken to train men in the proper use of intelligently selected instrument equipment. Here is an extract from a report from a supervisor of power to the manager indicating what intelligent training can accomplish with the use of instrument equipment:

> . . . . it is evident that in the four months preceding the installation of the boiler control board, the savings on fuel, due to various steps taken, averaged $435 per month while, in the four months following the installation of the instruments, the savings computed on the same basis averaged $1,145. In other words, the increased savings, due solely to the intelligent use of instruments on the boiler control board, was $710 per month or $8,620 on the annual basis, which means that the expenditure of $2,080.46 for instruments of the said board is an investment which, in our case, yields over 400 per cent. profit.

This statement is by no means exaggerated since the plant is a comparatively small factory installation consuming from 150 to 250 tons of coal per week. Two boiler control boards are shown in Figures 17 and 18.

In this connection it might be of interest to cite the description of a typical installation of a boiler control board, as devised by the writer, given in a paper by the mechanical superintendent of a large paper company.

> An instrument board was installed in each boiler room in a location to be readily seen by the firemen. Upon the board were mounted steam flow meters piped to each boiler, a draft gage, indicating draft in boiler uptake and furnace and pressure in ash pit, a recording thermometer with two pens recording temperature of feed water entering economizers and boilers, and a flue gas pyrometer connected to a thermo-couple in each uptake to indicate flue gas temperature. Adjacent to the board is the Venturi feed water meter, a gas collector and analyzer, and a portable recording flow meter. The draft gages are piped to each boiler in such a way that through a system of valves operated by levers, the draft in uptake and furnace and ash pit pressure can be obtained by pressing the lever corresponding to any boiler. Likewise, the temperature of flue gases may be read by making the proper electrical connection for any boiler by turning a hand wheel.
>
> The installation of instruments on a boiler control board has several unique features:
>
> (a) Only steam flow meters are individual for each boiler, all other instruments could be selectively connected with any boiler.
> (b) Indicating instruments are those needed for control and adjustment of working conditions of boilers.
> (c) Recording instruments are those registering data necessary for computation of results.
> (d) Centralization of instruments reduces first cost (investment).
> (e) Centralization of instruments affords observer or head fireman the opportunity to compare instantly the working of all boilers in the plant, or of any one.

The progress of installation of instruments should be utilized as an opportunity for education. The very important factor for learning something is the interest aroused on the subject, and this is invariably the case when new devices appear in the plant. Their purpose, use and service-value should be explained before they become permanent fixtures, since, if this opportunity is lost, the instructor has a doubly hard job as we seldom have sufficiently keen interest in old, familiar objects.

(To be continued)

Labor Turnover on the Great Lakes

Reference has already been made to the heavy turnover of labor on the Great Lakes.* Regardless of whether union control or Association** control was most equitable, it seems certain that the work of a sailor on the Great Lakes was no more attractive an occupation in 1916 than it was under the union regime. In spite of the welfare plan there were in 1913, on the average, nine changes made to keep each deck hand job filled; six for each porter's job, six for each fireman's; four for each wheelman's; four for each watchman's; and four for each ("second") cook's. In 1913, when the number of men required to completely man the Association's fleet was 10,476, the number of shipments was 52,094, making a turnover of about 400 per cent. In 1916 the situation was still worse, for, with a normal aggregate crew for all the fleets of not more than 12,000 men, there were shipped 73,823, a turnover of more than 500 per cent!

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* U. S. Dept of Labor, Bureau of Labor Statistics.
** Lake Carriers' Association on the Great Lakes.

Development of the Health Department of Thomas A. Edison Interests

By Mark M. Jones

How to increase human effectiveness is one of today's problems in American industry. An important aid in its solution is the factory health department, that treats injuries, illness during working hours and occupational diseases, oversees the sanitation of the plant and conducts health education.. This article describes how a department to do this work was developed and brought to a high standard of results.

Mr. Mark M. Jones' *early experience included the position of street car conductor, clerk and chief clerk in the traffic department of a street railway company in Waterloo, Iowa. Later he was traffic manager of the William Galloway Company. Relocating in California, he held several positions connected with traffic, finally becoming industrial secretary of the Oakland Chamber of Commerce. In 1916 he came East, to undertake his present work as Supervisor of Personnel of the Thomas A. Edison Interests at Orange, N. J.*

ADMINISTRATION of health department activities is essentially maintenance work. The department must maintain personnel as efficient producing units capable of such effort as their primary qualifications may warrant. Its work is also a matter of morale. It must do its part in establishing an individual "atmosphere" in the plant, and must occupy the position of the grandmother to whom the youngster may go when indisposed, or when he cuts his finger and needs a bandage. He should receive treatment that causes him to wish to return, and the sympathy that causes him to feel that after all it is a good thing to work in a plant that takes such good care of him. It is just as important that the injured receive the sympathy that would be accorded a child by his grandmother. It must be a very "human" institution, and it is no place for cold personalities.

While a well organized health department is a humanitarian agency, it is not out of the dollars and cents realm. It can inspire in the management of an enterprise the same feeling enjoyed by a certain prominent lawyer who said: "When I can do good and make money at it, then all my functions are working in harmony." There is a distinct obligation resting upon industry to look after the health of its workers, and as it bears so directly on the joys and sorrows of workers, no other function can be carried on with a greater feeling of satisfaction to the management. At the same time it pays.

The human body is a more highly adjusted mechanism than any machine in industry, and an industrial health department must lead the movement for wider knowledge of its care. Workers must come to appreciate that it is far more important to understand thoroughly the workings of the human body than any machine they might apply their energies to. While self preservation is considered the first law of nature, the average person is woefully lacking in the knowledge necessary to carry it into effect, as many industrial accidents demonstrate.

WORK OF OUR HEALTH DEPARTMENT

The work of a health department must be builded upon a strong foundation of confidence. If confidence in the hospital staff is lacking, workers naturally will not avail themselves of the service. If visiting the hospital means a clash of personalities and proves an unpleasant experience, all the fine equipment which might be crowded within its walls will be of little use. The Edison Health Department is the result of the enthusiasm of a strong personality. Doctor Charles W. Banks, who heads it, is a surgeon of wide experience, with an unusual capacity to administer to wounds of the spirit as well as those of the flesh. His untiring devotion has created in a remarkably short space of time a specialized staff organization for handling all phases of health in the Thomas A. Edison Interests. The department is concerned with:

1. Occupational diseases.
2. Casualties.
3. Illness.
4. Sanitation.
5. Health education.

The primary aspect of the Health Department's work is the treatment of casualties. Hospitals should be conveniently located for immediate access in case of serious injury, and must occupy the same position in this respect that the large hospital occupies to the many activities of a city. Our hospitals are equipped to render any service to the injured, from the resetting of broken bones to amputations. They are open to workers for service at any time during working hours, and treatments for illnesses have greatly increased in number. Supervisors noting that certain workers do not seem to act naturally, make inquiry and send them to the hospitals if a matter of health is involved, so that it is generally possible to do something for them that will brace them up and enable them to return to production at once, rather than lose the balance of the day or several days through leaving the plant and not consulting a physician. So far as illness is concerned, it also provides a most important check upon the quack who preys upon illiterates and certain foreign nationalities. It affords workers the opportunity to secure a quality of service that could never be otherwise obtained. Our health department carefully follows matters of sanitation and works in close coöperation with the safety department in improving conditions and preventing illness and injury.

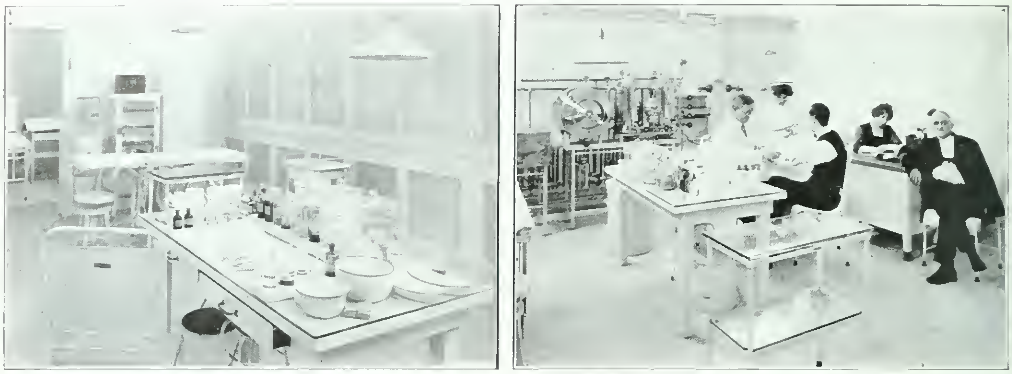
HEALTH EDUCATION

A health department can accomplish most important results along educational lines. The great need for this is apparent to anyone coming in contact with industrial workers. The barn can be locked before the horse is stolen in a large number of cases, and we are planning through lectures and special articles in the *Edison Herald* to carry on an aggressive campaign in this respect.

The health department must serve four masters: worker, management, executive, society. To the worker it must give the specialized service that the staff service department offers an organization on other functions. To the management it must render that service which makes the policies or ideals of the industry a very real and living thing. With the executive it must so coöperate that he is not embarrassed by low human efficiency. To society in general it must serve as the agency to carry the advanced thought of the times on health matters on to the firing line in industry, and so do its bit in making that particular section of the world a better place in which to work and live. The final test of its efficiency is its ability to balance each of these four obligations. Undue emphasis on either will not produce the comprehensive result that should be its consistent ideal at all times.

Our Plant Hospitals

Two hospitals were set up at the outset and have been equipped in a most complete manner. One is located at Orange and serves the larger group of Edison industries, while a smaller one is situated at Silver Lake. The equipment of the main hospital at Orange is sufficiently great to permit handling major operations, and it is therefore seldom necessary for us to send the injured to outside hospitals. The Orange hospital consists of the doctor's office and laboratory, waiting room and safety museum, stock room, dark room, dormitory with two beds, and the operating room. It is located approximately in the center of the plant on the ground floor, convenient of access from all points. The doctor's office and laboratory is equipped for physical examination, blood analyses, urine analyses, etc. It will ultimately have an X-ray outfit as a part of its regular equipment. The waiting room and safety museum is being equipped with photographs and illustrations showing the results of carelessness, directions in case of accident, X-ray plates, etc. It will afford an opportunity, for him who waits, to secure a few lessons in the price of carelessness. The stock rooms carry a central stock of medical supplies available to both hospitals, and for the first-aid cabinets located in various sections of the plant. The operating room is a striking example of Mr. Edison's thoroughness in carrying into effect his belief that no provision should be spared which will work to the comfort and convenience of workers. A list of the main items of equipment follows: Instrument sterilizer, dressing sterilizer, hot water sterilizer, cold water sterilizer, basin sterilizer, irrigator, blood pressure apparatus, haemoglobin scale, Fairbanks scale, urinalysis set, electro-magnet, operating table, klaarlight, Berger's loop, electric bake oven.



HOSPITAL MAINTAINED FOR EMPLOYEES BY THOMAS A. EDISON INTERESTS

Two doctors and three graduate nurses comprise the medical staff.

The hospitals reach out into the organization for first aid to the injured through first-aid men located in various departments. These men are supplied with a small first-aid cabinet with the one standard equipment, consisting of the following: One ounce absorbent cotton, 2 ampules of iodine, 2 rolls 1-inch bandage, 2 rolls 2-inch bandage, 2 packages sterile gauze dressings, 1 ounce Jamaica ginger, 2 ounces 4 per cent. boric acid solution, 1 tournequet, 1 roll adhesive plaster, 2 ounces aromatic spirits ammonia, 2 ounces carron oil, 1 pair scissors.

At the outset the cabinets contained all the supplies installed by the manufacturers. It was soon found, however, that the equipment was more elaborate than was necessary for our use, and it was therefore reduced to the above list.

Stretchers are located at convenient points in different plants. First-aid men are instructed to only take such action as may be absolutely necessary to prepare the injured for the trip to the hospital. The Edison organization insists that every injury, no matter how trivial, be sent to hospital for attention.

Accident Reports

Accident reports are started at the hospitals. When the injured reaches that point for his treatment, section No. 1 is filled out in duplicate and sent to the foreman or superintendent of the department in which the injured was engaged. Section No. 2 is then filled out by the foreman or superintendent, one copy is retained for his records and one copy returned to the hospital for the use of the safety department. A follow-up is kept to make certain that every report is promptly returned. Casualties indicating faulty equipment are called to the attention of the safety supervisor at once, and steps are taken to make immediate correction.

At the outset we gave instructions to first-aid classes and planned to have them do a certain amount of the work in departments not in close proximity to the hospitals. It was found, however, that "a little knowledge is a dangerous thing" and that first-aid men might be inclined to over-estimate their own abilities to the sorrow of the worker. To have iodine spilled on the hand during the treatment of a small cut, and then bound up, produces a result that is not particularly pleasant, and experiences along that line are not infrequent among ambitious first-aid workers. We have found it far better to insist that all cases come to the hospital, in order that anything may be caught in its incipiency and development prevented rather than cured after a dangerous stage had been reached. The result of neglect is generally far more serious than the original injury, in industry as well as on the battlefield.

Occupational Diseases

In the treatment of occupational diseases particularly in chemical industries, the health department is called upon for original research of pioneering nature. Workers handling coal tar products suffer from maladies now better understood than a short time ago, but still presenting many serious problems.

The industrial hospital service should be prepared to handle without charge any illness that may develop as the result of occupation. It should then coöperate with the operating head to make certain that everything possible is done to prevent recurrence of such cases. Coöperation of this nature has enabled us to bring down the number of occupational cases to what might be considered almost an irreducible figure.

In addition to providing an agency for the administration of health matters, the hospitals afford a most important point of contact with the organization generally. The joys and sorrows of workers are more quickly registered at hospitals than at any other point, and we make it a uniform policy to investigate and straighten out any irritation that attention is called to in the hospital. The attitude of the worker before the doctor or the nurse seems to be entirely different than when in the presence of his foreman, and as he feels less restraint he usually voices his innermost thoughts. In this way many minor difficulties of a nature that sometimes cause workers to leave come to light and can be corrected. In those cases where workers feel that the work affects their health, they may appeal to the doctor for advice and assistance. Where it appears that health is actually affected, they are naturally transferred at once, and where it is not the case an explanation from the doctor accomplishes more than the foreman could ever expect to do. The information is imparted at the right time and place by the right person when it comes from the doctor. The worker is then "sold" and the difficulty quickly adjusted.

Influence of Hospital Staff

Workers feel that a hospital is a sympathetic agency with no interest other than assisting them to good health and happiness, and do not hesitate to appeal to it when it can be of assistance. It seems very clear from our experience that the use and value of the health department depend largely upon the hospital staff and the equipment provided. The young, inexperienced doctor is a liability rather than an asset. He does not inspire a feeling of confidence. On the contrary workers feel that they are being practiced upon. It is far better to have a surgeon with wide experience on casualty work at the head of the staff than the novice who is only starting his career. The experienced surgeon can accomplish great results, not only from a health standpoint but from that of creating an atmosphere which causes men to feel, "It is a great thing to work at Edison's; they take the best of care of their workers." If the novice is used it should only be under the immediate supervision of an older and more experienced surgeon. Experience plus personality plus organizing ability make the most successful industrial surgeon. The equipment of a hospital also inspires confidence and is an invitation to workers to use it. The poorly equipped, semi-temporary first-aid room, such as is often found in industry, soon comes to be regarded as a necessary evil and is only used when absolutely necessary. One inspires confidence, the other does not; one is widely used, the other only in cases of absolute necessity. One accomplishes great results, while the other does not justify its existence; one is an asset, the other a liability.

Work of this sort affords those responsible for it a great pleasure. It is the most direct influence upon human efficiency that can be applied. As stated before, however, it has a most distinct dollar and cents aspect. Human efficiency is directly reflected in the amount of lost time occurring in the plant. The educational work of the health department will prevent illnesses in the first instance. Intelligent treatment will speed recovery and thus reduce the number of days of absence. Every day's absence means less production, and the health department is thus directly linked with actual manufacturing. Treatment of illnesses prevents leaving the plant and reduces lost time.

Much can be done to reduce malingering. The health department of Thomas A. Edison Interests has accomplished more satisfactory results in this respect than ever was anticipated. It has speeded recoveries to the point where, during its first year, it reduced the number of cases in which compensation was paid approximately 75 per cent. This was not only of direct financial benefit to the organization, but to the worker as well. His income when incapacitated is naturally impaired, and the sooner he recovers and can use his resources without impairment, the sooner his income again reaches normal. It is now a rare thing to have more than one week's time lost as the result of a casualty.

Human efficiency is no less a problem than mechanical efficiency in American industry to-day, and the modern health department must play an increasingly important part in maintaining personnel. Its alertness and judgment control the destinies of human beings, and such an obligation cannot be lightly discharged.

The Blind Taping Coils

Last fall the question of securing some help from the blind was taken up by the Westinghouse Electric and Manufacturing Company with the Pennsylvania Association, a branch of which is located in Pittsburgh, and a sample lot of motor coils to be taped was sent to the Association in order that the employer might be given a chance to show what they could do. When the coils were returned, it was very evident that this work could be done in an entirely satisfactory manner by those who have been deprived of their sight. Accordingly, arrangements were made with the management of the Association to allow some of their employees to do this work, payment to be made on a piece work basis.

South Philadelphia Works of the Westinghouse Company

Features of New Plant to Build Power-Plant Machinery

To care for the greatly increased demand for power plant equipment, particularly for ships, the Westinghouse Electric & Manufacturing Company has erected new works near Philadelphia. This article takes up its engineering and constructional features including the selection of the site, the plant layout and the buildings already erected, which include the pattern storage building, foundry, forge shop, power house, erecting shop and two machine shops. The systems for the distribution of electric current for power and lighting, the domestic and drinking water supplies, and the sewage systems are described in considerable detail.

RECENT developments in, and demand for, steam-electric generating units, have led to a greatly increased production of steam turbines, condensers and their auxiliaries. The use of electricity for ship propulsion, and the application of reduction gears, has also greatly added to this demand. These developments, together with the power requirements for marine work, led to the consolidation of the Westinghouse Machine Company with the Westinghouse Electric & Manufacturing Company, the former becoming the machine works of the latter.

To care for these increased demands for power machinery in a satisfactory manner, it was necessary to enlarge the manufacturing facilities of the company to a very considerable degree.

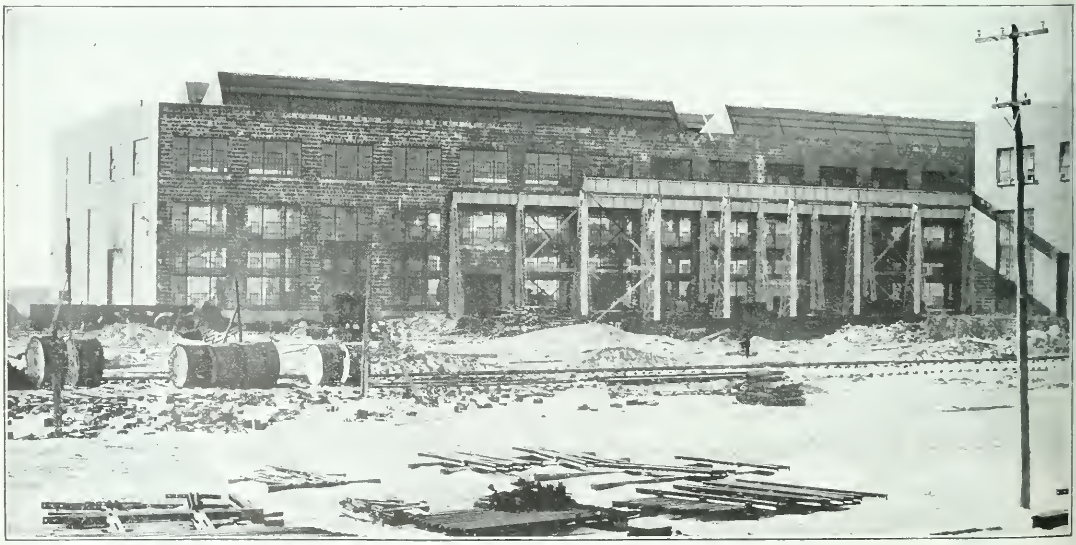
As the East Pittsburgh plant has already expanded to a point when it employs approximately 25,000 people and occupies in the neighborhood of 100 acres of floor space, it was decided to secure a suitable site elsewhere for further expansion. This decision was reached, primarily, because there is no more desirable land available at the original site for the erection of additional buildings, and also with the large number of employees mentioned it was considered more advisable to inaugurate a new industrial center, which would be capable of adequately taking care of future developments.

In the selection of a location for the new plant, the following requisites were borne in mind: an adequate area for present and future buildings, and an ample supply of good water required by the character of the apparatus to be built. Those charged with the selection also always bore in mind the importance of securing a location that would be central in regard to the activities to which the finished product was to be applied and, also, the very vital questions of the employment and housing of labor.

Accordingly, a plot of land embracing 500 acres was secured at Essington, or South Philadelphia, on the banks of the Delaware River, in Delaware County, Pennsylvania, nine miles south of Broad Street Station, Philadelphia.

Transportation to and from the works is afforded by the Pennsylvania Railroad, the Philadelphia and Reading Railroad, and a branch of the Philadelphia Rapid Transit Co., running to Chester, a few miles below. The Delaware River also provides a means of transportation, though as yet no steps have been taken to utilize it.

After the acquisition of the property, the general plans were outlined by Westinghouse officials and



VIEW SHOWING MACHINE SHOPS NOS. 1 AND 2, AT ESSINGTON, SOUTH turned over to Westinghouse Church Kerr & Co. to design, and erect the initial buildings.

At the present time the plant is devoted in its entirety to the production of ship propulsion machinery for the United States Government, including steam turbines, condensers, gears, and other marine accessories, which are intended for the Submarine Boat Corporation and Merchant Ship Building Corporation, as agents of the Emergency Fleet Corporation. Torpedo boats of our navy are also being supplied with turbines and reduction gears.

The site was selected in the summer of 1916. Construction began early in 1917 and has progressed at a rapid stage until now there are seven buildings erected, and over 2500 people employed. Provision has been made for a town site that will take care of at least 5000 people, though as yet no housing has been erected.

The buildings at present erected are the pattern storage shop, foundry, forge shop, power house, erecting shop, and two machine shops. They afford a floor space of approximately 600,000 square feet.

The character of the apparatus to be manufactured here was known at the time the plans were drawn, and this information, together with the needs for future extensions, were carefully borne in mind when the final decisions were made. In addition,: the knowledge gained from the construction and operation of the shops at East Pittsburgh was a guide of very considerable value.

Types of Building Construction

The pattern storage building, the dimensions of which are 400 x 135 feet, has four stories and a half-basement. It is of reinforced concrete, flat-slab, mushroom-type floor construction. The intermediate panels between the concrete columns are of tile. It is well lighted, equipped with modern tools, and has the best facilities for the comfort of the workmen. At the present time this building is also used to house the general offices of the plant. At a later date an office building will be erected.

On the top floor of the pattern storage building are located the kitchen, and the dining room in which meals are served to the office force and the shop foremen. The dining room will seat 300 persons. Eventually some ten lunch counters, each complete with ice chest, steam plates, etc., will be located throughout the various buildings. At these places employees will be able to obtain fruit, sandwiches, soup, coffee and milk at the price of five cents a portion.

The remaining buildings are of heavy steel construction; the walls are of tile, the sash of steel, and the roofs are of the familiar saw-tooth type. The roof covering material consists of concrete slabs covered with Johns-Manville asphalt asbestos waterproofing material.

The Foundry

The foundry is approximately 630 feet long by 200 feet wide. It is light and airy and is equipped with cranes to handle both the raw materials and the finished castings. In the center are three cupolas with charging floor, blower equipment and elevators, an extension of this provides for large toilet and locker rooms for the employees Three air furnaces are also included. The core ovens are housed in one of the bays, which also provides for a foundry store room, blacksmith shop, metallurgist's quarters including chemical laboratory, testing machine and offices. Track scales are provided at each end of the building for weighing the finished castings.

A unique and interesting feature in connection with the foundry is the arrangement for sand storage. Frequently the production of foundries is held up owing to lack of sand. To obviate this difficulty a sand storage and mixing plant has been installed in the basement of the pattern storage shop, from which point the sand is carried through a large underground tunnel to the various bays of the foundry. It is thus possible to store an ample supply of sand and to assure its delivery to the foundry without fear of interruption on account of the weather. Incidentally, a very material saving over storage outdoors is anticipated. The furnaces are charged from automatic elevators. In case of any trouble with these elevators, the charging materials can be elevated to

PHILADELPHIA, PA., RECENTLY ERECTED FOR THE WESTINGHOUSE COMPANY the charging room by the cranes in the storage yard alongside of the foundry.

The toilet rooms are separated from the wash rooms, and both are plentifully distributed throughout all the buildings.

Particularly noticeable throughout the works is the large number of cranes, particularly jib cranes, it being recognized that lack of transportation facilities often means the enforced idleness of labor.

The forge shop, approximately 300 feet long by 80 feet wide, is now being equipped with furnaces and forging machines. This equipment includes one 350-ton and one 1000-ton steam hydraulic press, a 1500-pound hammer, four annealing furnaces, hand forges, case hardening and tool dressing appliances.

Machine and Erecting Shops

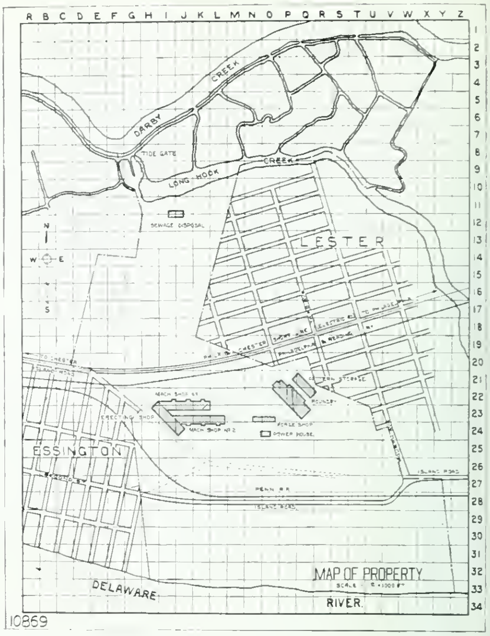
Decidedly the most imposing looking structure at present erected is the combination of the two machine shops and the erecting shop. The machine shops, each approximately 750 feet long by 135 feet wide, are located parallel to each other and spaced about 85 feet apart. They are joined at their western extremities by the erecting shop, which is approximately 550 feet long and 135 feet wide, and set at an angle of 45 degrees with the others. The three buildings together form the principal architectural feature of the works. The erecting shop is equipped with provisions for testing steam turbines, condensers, pumps and reduction gears. Water for testing purposes is brought from the Delaware river as explained below.

Particularly noticeable is the angle of 45 degrees at which the erecting and the two machine shops are placed. It has been found that much time is lost and maintenance costs increased in industrial plants on account of the fact that the curvature required by tracks to reach the different buildings is too short for the satisfactory handling of cars and locomotives. In this installation the 45-degree angle affords an easy curvature into any building from the yards, and *vice versa*. Another important feature of this angle is that, in addition to the free access afforded from the machine shops to the erecting floors on both the ground floor and balcony, the triangular space created by the intersections affords room for offices, fans and storage of materials. A portion of this intersecting space which is divided into main floor, balcony and two mezzanine floors, is used for the works offices.

Forty-foot galleries used for small machine work run around all three buildings, overhanging balconies being provided at frequent intervals for the purpose of unloading material from the cranes that is too heavy to be handled by the elevators serving these balconies. The apprentices are employed on one of these galleries.

The space between the two machine shops is used as a storage yard and is spanned by a 30-ton crane, the runways of which are supported on a steelwork structure erected alongside of the buildings.

All of the buildings are connected by a system of concrete underground tunnels in which are carried the pipes for steam heat, water, air, and conduit for the electric wiring, thus ensuring an absence of all overhead piping and wiring. This feature adds greatly to the appearance and the reliability of the plant.



PLAN VIEW SHOWING LOCATION OF VARIOUS BUILDINGS

Transportation of material to and from as well as throughout the various buildings is facilitated by a system of railroad tracks, all of standard gage, so that interworks cars, locomotives and trucks, as well as railroad equipment, may be operated over the same tracks. In this way, the disadvantage of maintaining tracks and equipment for different gages is obviated.

For handling castings between the storage yard and the various buildings, four 10-ton, burden-bearing, Baldwin-Westinghouse storage battery locomotives, with trailers, are used. These trucks are capable of carrying a load of 50 tons each.

For light trucking about the buildings and through the tunnels, Elwell-Parker trucks are used. The batteries of the locomotives are charged from the 250-volt d. c. circuit at convenient points; the batteries on the small trucks are charged from special motor-generators, one in the tunnels and one on the surface.

EXTERIOR VIEW OF FOUNDRY—NEW WESTINGHOUSE WORKS

Power and Lighting Supply

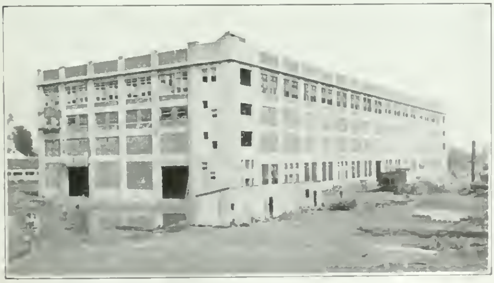
The engineers responsible for the lighting and power system were peculiarly fortunate in that they could design with, at least, an approximate knowledge of future demands. This is a condition which is in decided contrast to those usually found in large plants.

In securing a power supply the company determined to avail itself of the facilities of The Philadelphia Electric Company which furnishes current to the surrounding territory. It so happens that the load carried by this company is much greater in the winter than in the summer, in which period it has surplus capacity. Conversely, steam is required by the works in the winter for heating the buildings but not in the summer, although a small amount is always needed for testing.

POWER HOUSE AND FORGE SHOP

A mutually satisfactory arrangement was therefore arrived at by which The Philadelphia Electric Company supplies 66,000-volt current in the summer months when it has the reserve capacity, and in the winter the Westinghouse Company is to generate current in its own power plant by means of steam turbines which operate non-condensing and discharge the exhaust steam into the heating mains.

The 66,000-volt, three-phase, 60-cycle current is delivered to an outdoor substation which contains transformers for lowering the pressure to 6,600 volts, and other control equipment. Current at the lower pressure is carried by underground cables to the power house from which it is distributed over the works.



PATTERN STORAGE SHOP—AT PRESENT USED FOR OFFICES

The Power House

The power house is a substantial fire-proof building, approximately 200 x 100 feet in size, which in line with the remainder of the power and lighting system will readily permit of enlargement in case of future demands.

For supplying steam to the turbines, and superheated steam to the erecting shop for testing purposes, there is installed a battery of six 625 hp. Stirling boilers, equipped with Westinghouse automatic underfeed stokers.

Coal is delivered to the power house over the railroad tracks from which it is dumped to pits and from there raised by electrically operated conveyors to the breakers. Provision is also made for removing the ashes from the furnaces to overhead ash bins from which they are discharged to railroad cars on a track outside the power house.

YARD BETWEEN THE TWO MACHINE SHOPS, SHOWING CRANE

The present generating equipment consists of three 1,500-k.v.a., 6,600-volt, 3-phase, 60-cycle, 3,600 r.p.m., non-condensing turbine generator units, with room provided for the future addition of three 3,000 k.v.a. units. The output of the plant is controlled from a 21-panel switchboard located on the turbine floor, containing the usual complement of switches, meters and control equipment.

In view of the considerable area to be covered, it was decided to generate at 6,600 volts and to make distribution at this voltage by underground cables to sub-stations located at various points throughout the works, in which the voltage is stepped down to 440 volts for all applications calling for constant speed motors, such as machine tools, air compressors and elevators. Direct current at 250 volts for the operation of variable speed machine tools, blowers for furnaces, cranes and other devices requiring this form of energy, is furnished by rotary converters installed in these stations.

The lighting system is entirely separate from the power supply, being supplied through separate transformers located in each substation, which reduce the distribution pressure from 6,600 to 440 volts at which potential the lighting current is sent through the buildings. Transformers located on the outside walls of the buildings reduce this pressure to 110 volts for the Mazda lamps, which range in size from 40 to 1,000 watts.

Water and Sewage Systems

Water for drinking, cooking and other purposes requiring pure water is supplied from the Philadelphia city water works system.

Water for other purposes is taken from the Delaware River through a seven-foot open canal, having a surface width of 45 feet at high tide. Mud and silt are removed by means of a concrete settling basin located between the river and the plant. A connection for condensing water is taken to the power house through 30-inch piping.

Employment and Labor Maintenance

A Special Department to Aid Employment Executives

Basis for Selection of Employees

By N. D. Hubbell

Employment Supervisor, National Carbon Company

THE abiliy to select competently is not a thing which can be acquired over night from a book or teacher, but considerable has been written which will help the employment man in this connection. The employment problem has been carefully studied from various angles by capable men who have concentrated on one phase of the work and carried on exhaustive studies, the findings of which are now available in concise form. This information is an invaluable source of suggestions and should be utilized to the fullest extent. His own experience will in time teach him what can be adapted to his own peculiar conditions. There is also prevalent the idea that the ability to select is born in some and not in others. This is true to the extent that some men have a better natural understanding of human nature than others. Of course, the employment man should have this instinctive human interest but this is only the starting point. The knowledge and ability to select competently come only after considerable preliminary work has been gone through with. Most of this experience will have to be acquired on the job, from the shop, from the people in it, and from the records.

Assuming that preliminary study has been done sufficient to establish the work, the employment manager should build up for his guidance a vast fund of information, the principal points of which may be outlined as follows:

1. INFORMATION IN ADVANCE AS TO VACANCIES

The necessity for filling "rush orders" for help is one of the worst factors the employment man has to contend with. Realizing that production is being hampered, he will be forced to pick the first man who comes in who is at all fitted for the job, instead of carefully selecting a man whom he feels sure is capable and reliable he takes a chance. He defeats the object of the employment department because it was to get way from taking such chances that it was established. Although it is not practicable to hold up production by refusing to fill rush orders, much can be done to eliminate them by:

A. *Educating foremen to eliminate "rush orders" as much as possible.*

(a) Carefully investigate all "rush orders" sent in by foremen to find out why the "rush" is necessary, and how it could have been avoided.

(b) Educate foremen to the necessity for anticipating extra requirements as far in advance as possible from the volume of work ahead of the department.

(c) Educate foremen to the necessity for notifying providing someone to take his place.

B. *Adequate provision for advance information from planning department.* It is essential that the employment men know in a general way the amount of work ahead of each department.

C. *Educating workmen to give notice of leaving.* Quitting without notice is without doubt the reason for the majority of "rush orders." Much can be done, however, to educate workmen to give notice of leaving, such as,

(a) A campaign to point out to employees the necessity for giving notice of leaving. This can be done by personal contact, notices in the house organ, in the pay envelope and on the bulletin boards.

(b) A plan for paying off in full when they leave those who give sufficient notice and making others wait until regular pay day for their money.

(c) An understanding with the employees that quitting without notice will be counted against their records should they apply for reemployment or want references from the company.

(d) A plan for checking up records of previous employment to see if applicants have left without notice before.

D. *A plan for the company to give notice to a workman when letting him out through no fault of his own.* One of the chief reasons for workmen not giving notice is that the system is being worked as a one-sided proposition by most concerns. The workman's argument is, "Why should I give notice? I don't get any when they are through with me." In most cases his argument is valid. Until concerns handle the notice of leaving on a 50-50 basis and give workmen a few days' notice or extra pay when laying them off, they cannot expect employees to give their coöperation on this proposition. This, of course, does not apply to workmen who are discharged for malicious conduct, insubordination, etc.

2. A THOROUGH KNOWLEDGE OF WHAT MATERIAL IS AVAILABLE

To hire intelligently the employment man must be familiar with the labor market in general and specific help available for his own use. This naturally includes:

A. *A list of applicants available.* Under present conditions it cannot be assumed that an application put on file will be good for very long, but it is pretty generally conceded that for certain classes of help the "shelf list" can be used to advantage.

B. *A knowledge of the labor market in the locality.* The employment man must be the eyes and ears of the organization for all information regarding conditions affecting the labor supply. Coming in contact with workmen applying and with other employment men, this information will naturally come to him. It includes:

(a) Knowledge of any strikes, layoffs, shops running slack, substitution of women for men, and any other factors tending to increase the labor supply.

(b) Knowledge of new shops starting up, other shops building additions or increasing their forces, calls for military service and any other similar factors.

3. A GENERAL WORKING KNOWLEDGE OF ALL OPERATIONS TO BE PERFORMED

The employment man must be thoroughly familiar with the shop conditions under which employees must work. In addition he must have a knowledge of all operations sufficiently accurate and detailed to enable him to intelligently question an applicant. To do this it is not necessary for him to be able to perform all operationsn but he must know the shop terms which apply and be able accurately and comprehensively to discuss the essential factors entering into the job.

4. Knowledge of Rates and Earnings

To sell the job to the applicant it is absolutely essential that the employment man should have accurate knowledge covering earnings and methods of wage payment. This will include,

(a) Day rates paid on all jobs in the shop and probable increases.

(b) Periodical averages of piece work earnings by individuals and classes of work.

(c) Knowledge of rates paid in other shops in the locality insofar as it is obtainable. This will come from other employment men and statements of applicants.

5. Written Standard Job Specifications

As explained in a previous article, page 431 of the December issue of Industrial Management, a concise comprehensive form for recording uniform information regarding each job will be of decided value in familiarizing the employment man with the essential factors entering into the job, and it makes this information a matter of company record. The book of specifications will be a well organized note book containing complete uniform notes on each job. When signed by the foreman and employment man, such a specification puts them on a basis of mutual understanding of the job.

6. Investigation of Applicant's Past Record

A closer coöperation on the part of employment managers in the matter of verifying applicants' past records will weed out many of the undesirables and prevent concerns bidding against each other for men.

7. Character Analysis

Within the last few years much attention has been attracted to the "science of character analysis by the observation method." A careful study of the plan and a survey of the results produced by employment men trained under the plan point out clearly that there is much to the science which will help the employment man. It is for each to use as much as his experience justifies. It should, however, be considered as part of his training for selection.

8. Scientific Tests

An even more scientific basis for selection of employees is rapidly being evolved in the scientific laboratory tests now being worked out. Although few employment men will have the time to go into the exhaustive studies necessary to work out the tests basing them upon the law of averages, a study of the tests and methods will show some that can be adapted to the individual plant and also suggest other simple ones which will locate fairly accurately what qualifications are involved, and rate the applicant on these qualifications.

9. Trying Out Applicants on the Job

The idea of taking the applicant to the department for a superficial tryout before hiring should be discouraged rather than encouraged. The more efficient the employment department becomes the less will be the necessity for this.

10. Physical Examinations

Physical examinations of applicants by a competent physician will be advantageous from several standpoints.

(a) A group of healthy employees, on work for which they are physically fitted, will be happier, more contented and more productive.

(b) Accidents will be lessened with benefit to both employer and employee.

(c) Defects of eyesight, teeth, lungs, arches, etc., will be brought to light in time to be corrected.

11. Follow-Up Records of Employees

An accurate record of the performance of the employee when compared with his type will give the employment man valuable information for his guidance in selecting another man for the same or a similar job.

12. Data on Reasons for Leaving

A carefully compiled record of reasons for leaving on various jobs will point out to the employment man the peculiar conditions the workman will run into.

13. A Close Personal Contact With the Foreman

The success of the employment department is to quite an extent dependent upon the coöperation it receives from the foremen. The foremen as a group can make or break any employment man, consequently, it is essential for the employment man to keep in as close personal contact as possible with the foremen. Make them feel that the employment department is being conducted to help them and show them how it will accomplish it, then keep together with the foremen constantly on all subjects of mutual interest, such as, what jobs are open, what types are required, how new men are making out, how much work is ahead of the department, etc.

How Five Firms Keep Payroll Records Up to Date

By George B. Merriam

Supervisor of Labor Relations, Brown-Lipe-Chapin Company

IN the March issue of Industrial Management, page 234, you invite description of methods used to obtain interviews with workmen who leave without notice. The following method has proved effective with my company.

If a workman is absent 48 hours, his clock card is brought to the employment department to be called for on his return. Upon receipt of the workman's card, an "Absence Record" for the workman is made out with his name, number and date he last worked. This form is filed until his return or release. All essential information concerning the workman's absence is recorded on this form.

As this company pays off on Saturday, on Friday afternoon all "Absent Records" are sorted out for workmen who last worked during the previous week, excepting those whom we know are absent for cause.

For each of the above workmen three forms are next made out in one writing. The face copy is sent to the foreman and tool-crib clerk, as an inquiry concerning charges against them. This form is returned to the Employment Department. If the absent workman has not returned Friday night or Saturday morning, the face copy is sent to the cashier to be attached to the pay envelope.

The second and third copies are attached to the "Absent" form awaiting the workmen.

When the workman calls at the cashier's office for his back pay, he is sent to the employment office, where he is interviewed. He either states that he is through or that he will return on a certain date. If he says he will return, the date is noted on the

"Absent" form, he is given the second copy (pay order), which is presented to the cashier for his pay. The third copy remains attached to the "Absent" form until the date the workman is to return.

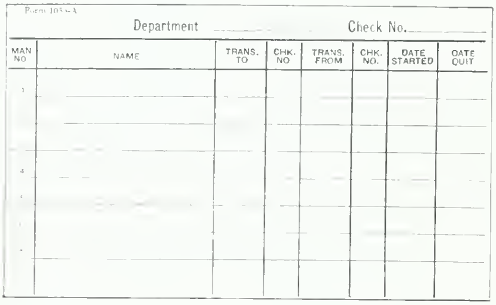
If the workman fails to return on the date specified, the third copy is sent to the time department, removing the workman from the payroll. If he returns, this form is destroyed, and the proper entries made on the "Absent" form.

By John C. Bower

Superintendent, Employment Department, Westinghouse Electric & Manufacturing Company

We have an office in the Employment Department where all records of tool accounts are kept, checks issued and collected, and where employees who are quitting are interviewed before applying at the paymaster's office for their money.

The rules concerning employees quitting are these: If three days' notice is given the employees can obtain their money on the day they quit, providing they check up in the morning. If no notice is given it is necessary for them to wait three days for their money. Discharged employees receive their money the same day they are discharged, or the next morning. Those who quit without notice are retained on the payroll for two weeks, when a quit slip is sent through, or if they apply before that time they are sent into the shop with a messenger, where they make up their time, check in their tools and sign their quit slip.



Form 105-A

Department ______ Check No. ______

MAN NO	NAME	TRANS. TO	CHK. NO	TRANS. FROM	CHK. NO.	DATE STARTED	DATE QUIT

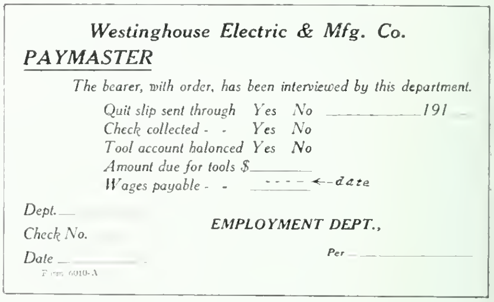
FIG. 1. EMPLOYEES' QUIT SLIP

The records of checks issued are kept on cards, an individual card being required for each check. The name of the employee holding this check, and the date it was issued to him, are reported on this card.

In the first case when an employee quits the procedure is very simple, as he signs a quit slip in the department in which he is employed, his time is made up, and after he has checked up his tool account in the sub-toolroom he is sent by a messenger to the Employment Department with a copy of his tool sheet, his time and his quit slip. The quit slip is made out in duplicate, one copy being retained by the Employment Department and the other accompanying his time to the payroll department. He is interviewed by the man who collects his checks, his tool account is adjusted, checks collected, and he is given a form properly filled in to present to the paymaster in order to obtain the money due him.

Should an employee decide to quit without notice while in the shop, the same procedure takes place, with the exception that his order to the paymaster is dated three days later.

If he applies at the paymaster's office for his money, stating that he has decided to quit, he is refused his money until he is able to present an order to the paymaster from the Employment Department. He is directed to that department to obtain the order. The card record of the checks issued show whether a slip has been sent through for him or whether he is still on the payroll. If he is still on the payroll he is sent into the shop with a messenger to sign a quit slip, obtain an interview with his foreman, make up his time and check up his tool account, if he has one. After that he is conducted to the Employment Department and given an order on the paymaster dated three days later.



Westinghouse Electric & Mfg. Co.

PAYMASTER

The bearer, with order, has been interviewed by this department.

Quit slip sent through Yes No ____________ 191__
Check collected - - Yes No
Tool account balanced Yes No
Amount due for tools $________
Wages payable - - ---- ←-date

Dept.______
Check No.______
Date ______

EMPLOYMENT DEPT.,

Per ______________

Form 6010-A

FIG. 2. QUIT SLIP-ORDER ON PAYMASTER

In this way we obtain an interview with all those who quit, or are discharged, with the exception of those who send in orders, in which case the one who presents the order is usually able to explain why the employee quit and where he is working at the time the order is presented. The accompanying illustrations, Figures 1 and 2, show the forms we use.

By Holland L. Church

Rockford Malleable Iron Works

The Employment Bureau of the Rockford Malleable Iron Works, Rockford, Illinois, is confronted with the problem of locating reasons for employees leaving service without giving their foreman or the Employment Bureau notice or reason for quitting. Since the bureau was established, a year ago, the writer has been working on the problem, which now seems practically cleaned up.

Our plant employs between 400 and 500 men, most of them foreigners, and not gifted with the American virtue of business responsibility. The writer endeavors to keep in touch with all of them, to know them personally, and to locate their particular friends in our organization. When an employee leaves without notice, his friends are interviewed and a little detective work often brings the desired information.

The plan of visiting absent employees in their homes is also found effective. In this way their intentions can often be learned. It frequently happens that the wife will say that her husband has gone to work. We know that he is not on the job, and the logical conclusion is that he thinks he has quit. We accept his viewpoint and fill his place. The absence of common laborers is not checked up so closely as that of the molders, as coöperation with our service department makes the following up of the latter necessary. Just now, when the labor market is tight and no small amount of visiting is advisable, the employment man's best friend is a "flivver."

The writer has found that more than 60 per cent. of the reasons for employees quitting have been located either by research work among their friends who are still with us, or by calling at their homes. Coöperation with the time-keeping department has enabled the writer to keep tab on all of the remaining 40 per cent. A rule is effective here that when an employee quits and returns after pay day for his check, it cannot be given out by the time keeper without the O. K. of the Employment Bureau. If the reason for the employee's leaving is unknown, here is the final chance to get it.

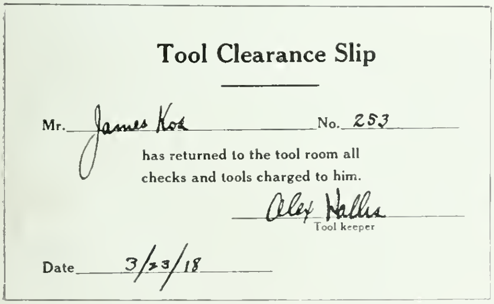
These heart to heart talks are very effective and, where the organization of the Employment Bureau makes it possible, this is a plan to be recommended.

By M. C. Hobart

Employment Manager, Albaugh-Dover Company

Several years ago this company was inconvenienced, as Mr. Parkinson of the American Optical Company states he is, by men leaving without giving notice to their foreman or timekeeper. We have succeeded in eliminating this trouble, and information as to men leaving of their own accord is now obtained as a matter of routine.

In the first place, we pay by check at the end of each week, but hold back one week's pay. That is, the check in payment for work done during this week is given out on Saturday of next week. Every workman when entering our employ, if his position is such as to call for the use of company tools, is taken to the tool crib of the shop in which he is to work, receives and signs a receipt for 12 brass tool checks, which he uses in drawing tools from the crib. When leaving our employ every workman without exception must obtain from the tool crib keeper a "tool clearance slip," shown in Figure 3, stating that the workman has no tools belonging to the company in his possession, and that the 12 brass tool checks corresponding to his clock number are back in the tool crib.



Tool Clearance Slip

Mr. James Kos No. 253

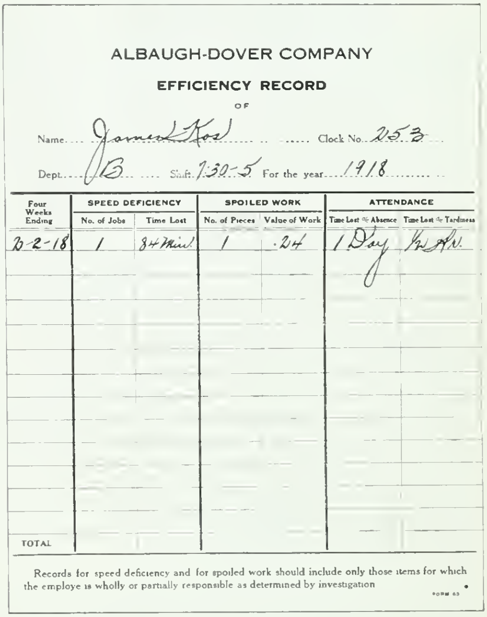
has returned to the tool room all checks and tools charged to him.

Alex Hallis
Tool keeper

Date 3/23/18

FIG. 3. TOOL CLEARANCE SLIP

In paying the men each week the pay checks for each department are taken for the foreman of that department and given by him to the men. If a man is absent on payday his check goes back to the payroll department and the workman must call at the office and obtain his check from the payroll clerk. *But no check is taken to the department foreman to be given to a man when that check is the last pay which that man has earned.* Such checks are picked out and sent to the employment manager on the supposition that the man is leaving, and every man when leaving must obtain his final pay from the Employment Department and there turn in his tool clearance slip. The particular checks which are turned over to the Employment Department are identified by the simple means of having the timekeepers take from the clock card racks each Friday afternoon all clock cards which have no working time recorded on them for the week.



ALBAUGH-DOVER COMPANY
EFFICIENCY RECORD
OF

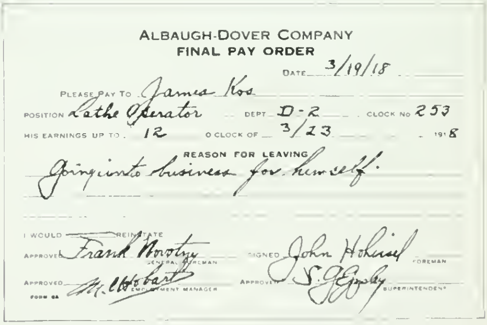
Name James Kos Clock No. 253
Dept. B Shift 7:30-5 For the year 1918

Four Weeks Ending	SPEED DEFICIENCY		SPOILED WORK		ATTENDANCE	
	No. of Jobs	Time Lost	No. of Pieces	Value of Work	Time Lost % Absence	Time Lost % Tardiness
2-2-18	1	84 Min.	1	.24	1 Day	½ Hr.
TOTAL						

Records for speed deficiency and for spoiled work should include only those items for which the employe is wholly or partially responsible as determined by investigation

FORM 63

FIG. 4. EMPLOYEES' EFFICIENCY RECORD



ALBAUGH-DOVER COMPANY
FINAL PAY ORDER

DATE 3/19/18

PLEASE PAY TO James Kos
POSITION Lathe Operator DEPT D-2 CLOCK NO 253
HIS EARNINGS UP TO 12 O CLOCK OF 3/23 1918

REASON FOR LEAVING
Going into business for himself.

I WOULD ~~—~~ REINSTATE
APPROVED Frank Novotny GENERAL FOREMAN
SIGNED John Hohisel FOREMAN
APPROVED M. C. Hobart EMPLOYMENT MANAGER
APPROVED SUPERINTENDENT
FORM 64

FIG. 5. FINAL PAY ORDER

At the end of each week all of the employees' clock cards are checked by the Employment Department, which notes absence and tardiness on the individual employees' efficiency record shown in Figure 4. Thus no absence can continue more than one week without coming to the attention of the Employment Department and be investigated, and no employee can leave without an interview with the employment manager.

If a man gives several days' notice before leaving, his foreman makes out a "final pay order," Figure 5. The two checks which are then necessary to pay the employee in full are made out and sent to the Employment Department in the usual way.

Diagnosing Labor Ills

By William Lamkie

To extend the lifetime and usefulness of its members is the objective of a distinguished national organization. The growing number of subscribers is evident appreciation of the valuable service rendered. The success of this agency is due to its scientific methods of diagnosis which is based on a thorough physical examination of each individual case. Without exception this course precedes the prescription of effective treatment for the ailments discovered. Then follows the periodic physical inspections the purpose of which is to safeguard the individual at all times against lessening his margin of safety. The emphasis is placed on the prevention of avoidable illness and premature death. This system applied by industry to ascertain the causes of the differences between employer and employee will bring correspondingly satisfactory results.

These industrial conflicts are preventable. They seldom arise among the increasing number of progressive enterprises with industrial relation departments which are equipped with modern employment management machinery. The supervisor of this division must possess the educational qualifications of a manager, be endowed with uncommon sense and have the experience sufficient to know the value of accurate information and understand how to interpret it. Such means will be used eventually by all concerns that are seeking the truth with which to find the final solution of the problems of labor.

Use of Employment Records

Through the employment records the approach is made to the study of the workmen and their environment. The information on file should show the conditions to be such that an investigation will lead to the source of trouble. Without this sufficient data it is impossible to know with any degree of certainty the real seriousness of an industrial situation. Unless the material gathered can be translated into significant, intelligible meaning, it will have no value whatever. In a recent audit of an enterprise with an excessive labor turnover the employment records were so unreliable, and the director of the department was so incapable, that a complete reorganization of the office was necessary before the investigation could proceed further.

The cost of the labor turnover can be figured quite accurately. Nothing is so convincing as the tangible evidence of waste in graphic form and money value. In an organization where the superintendent's prejudice against these efficient methods was encountered, every possible effort was made to meet his skepticism. Even the loss through transfers and old employees rehired was omitted in the computations. To maintain the payroll quota of less than 1100 at his rate of hiring the company would have had to employ during the year approximately 12,000. The conservative estimate of loss resulting in replacing the trained employee was $300,000. The basis for this was the minimum appraisal of $25 for damage and overhead charges in breaking in each new workman. The inexperienced in one department alone spoiled nearly $40,000 worth of product. On the transportation and board of workmen (engaged through unscrupulous employment agencies) who failed to report for work after reaching their destination because of unfavorable first impressions, an average of over $2,000 per month was spent. Some local industries greatly benefitted at the expense of their lax neighbor by bidding with their improved working conditions and market scale of wages for his service after the workman was imported. The great expense from those compensation cases resulting from neglect and incompetent medical attention was not included. Neither were the charges for the sickness and death of the unfit which medical examinations might have saved.

Quickening Interest

How can a concern maintain high standards of workmanship when it is confronted with a swiftly disappearing surplus of workers? Much of the remaining supply is the deficient product of a functionless school system and a prodigal industry in time of plenty. The elimination of the unnecessary motion and the reasonably quickening of movements in shop practice may tend to improve instead of impair the worker's health, which is contrary to the common belief. For in most cases, fatigue comes more from a lack of interest than from the actual expenditure of physical or mental energy in the daily performance of duty. Planning, dispatching and specifications for tasks are all essential. But a stimulus to this must be given in the form of generous incentives and wholesome surroundings.

What are the hazards which are impeding the progress of production? Abnormal working conditions and the constant application to task without diversions create much of the restlessness and desire for the greener pastures. Overtime is a demoralizing influence. A day in seven is none too much even for the most primitive natures. A break in the shift for a few puffs on his pipe, and a refreshing morsel with a hot cup of coffee, stimulates and sustains the laborer in his greater effort. The time and energy consumed by poor transportation to and from work might better be expended in creative work. Inadequate compensation or wages out of proportion to the cost of living attracts the floater and temporary job seeker getting a stake with which to pull out for another jump. Improved equipment for the workers' protection would cost a fraction of the settlements made for sickness, injury and death under the compensation act. Periodic physical examination saves time and suffering and keeps the employee fit. No asset is more important than housing for the permanent employee's family.

Harmonizing Relations

The relations of the manager to his workmen determine the attitude of his employees. In instances the problem rested solely in the employer himself. Most of the ultra-conservative already realize the folly of their way and are adapting themselves to the new order. Incompatible foremen drunk with power are responsible for much of the wholesale discharging. For this reason men chosen for this important leadership should be selected and trained with the utmost care and divested of final authority to dismiss a workman. The whole question resolves itself into one of good salesmanship. Too little consideration has been given the employees' reasonable demands and the causes back of them.

More effort will be made to prevent discontent and dissatisfaction from arising. The sources of trouble will be treated before there is time for a grievance to develop. The employer will place the study of the labor factor within the scope of scientific treatment. His employment records will have the same value as vital statistics for an insurance company.

Editorials and Comment

An Attack on Production

ON this page in the May issue INDUSTRIAL MANAGEMENT called the attention to the renewed attempt to pass so-called anti-efficiency riders to the pending appropriation bills. Industrial managers have witnessed these efforts for the past four or five years and will recall that the principal appropriation acts—those providing funds for the Army and Navy—have carried these hampering provisions.

The former opposition in Congress has in the main come from only a small group of interests. Some of the management experts have taken the trouble to point out that time study is but a means for measuring the rate and conditions under which work is done, and that the payment of bonus and premium is but the rewarding of diligent, intelligent effort.

Manufacturers' organizations, in the past, have expressed their disapproval of this attempt to hamper the methods of production, realizing that once the entering wedge was driven home in governmental industry, it will be an easy matter to spread the same restrictions to private plants, at least to those concerned with government contracts. But today when the country is at war the opposition to these restrictive riders is more vigorous and widespread than ever before. Employers' associations have arleady emphatically objected saying, as one did, that the proposal "approaches treason now, and will give aid and comfort to the enemy."

The engineers of the country have also gone on record in opposition as shown by the following resolution adopted by the Engineering Council:

> WHEREAS, the winning of the War imperatively demands highest efficiency and maximum production in every branch of industry; and,
>
> WHEREAS, we are informed that Congress has under consideration in the Naval and Army appropriation bills proposals to prohibit, diminish and condemn the payment to public employees or to employees of private establishments under Government control any cash reward, premium or bonus for superior service; and,
>
> WHEREAS, these methods if applied with due regard to wages; surroundings, health and safety of the employees, will increase efficiency and production, help win the War and preserve our institutions; be it, therefore,
>
> *Resolved,* that in the opinion of ENGINEERING COUNCIL, representing American Society of Civil Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers, and American Institute of Electrical Engineers, together having 33,000 members, it is vital to the winning of the War that no legislation nor other measure should be adopted which may interfere with highest efficiency and maximum production, but that on the contrary every proper means should be taken to increase efficiency and production.

The effectiveness of American industry is at stake. Will not each reader of these lines do his share and urge his representatives in Congress to vote against these restrictive riders.

Within a month a movement has been started in American industry which unquestionably stands alone and in the forefront of any similar efforts for the essential upbuilding of the health of labor. The initiative has come through the Commission on Training Camp Activities of the United States War Department. It has been inaugurated by the Director of the Section on Men's Work of the Division of Social Hygiene.

It is an appeal to industrial executives throughout the United States to inaugurate an educational, preventative and curative program in regard to venereal diseases. It has two great objects: To supply stronger and more effective recruits to the army from the men in industry who will enter the forthcoming drafts, and to increase the industrial effectiveness of the men who are engaged upon the great national war production programs. This work is needed because: 1. It is vital to the national defense; 2. it is vital to the working men to safeguard their homes and to keep them and their families physically fit; 3. it is vital to the employer because it tends to make labor more effective during these times of war; 4. it is vital to the prosecution of the war for it tends to produce a better army.

Literature has been prepared consisting of placards, folders and pay envelope enclosures carrying warnings of the ravages of this group of diseases and pointing the way to prevention and cure.

Industrial managers will be well advised to obtain specimens of this literature and consider the advisability of starting an educational campaign among their men. Special literature is also obtained for plants employing women.

Change in Machine-Tool Buying

EVERY executive in contact with a machine shop knows and realizes the change that is taking place in the character of machine-shop labor. Some 10 or 15 years ago we began to see the incoming in large numbers of the machine operator as distinguished from the mechanic.

The old time, all-round machinist could do any job in the shop; could operate any machine tool on the floor; do any piece of fitting or erecting and, in fact, was equal to any and every emergency. But years ago there were too few of him to go around, so less skilled men were broken in on individual jobs or on particular machines, and began to constitute a large proportion of the help. These men were usually referred to as machine operators and could, perhaps, get more production along the lines of their specialized knowledge than the old timer—but outside of the one thing they knew they were at sea in the shop.

The past few years of intense production in the manufacture of munitions, first for our Allies and now for ourselves, have accelerated and intensified this change. The proportion of machine operators to mechanics is now greater than ever before, and this proportion promises to increase very largely with the infiltration of unskilled men and the coming of women into our machinery building plants.

What has been the effect of this change in the character of machine-shop labor upon the selection and purchase of machine tools, machine-shop appliances, machine-shop supplies and the materials of machine construction?

Up to a decade or so ago most of these things were selected by men in the shop—the foremen and even the mechanics themselves. But this form of choosing is impossible today for the machine operators lack the necessary knowledge of what to select and the great number of machines and appliances offered make it necessary to pick with a much more careful consideration of merit and adaptability than is possible even by shop foremen.

So the natural thing has happened, the selection of machine-shop equipment has been pushed up along the group of industrial executives and is now in the hands of the superintendents, works managers and engineers.

The outcome will unquestionably be to the advantage of industry, for the men who are now responsible for the selection of this equipment are the ones who are responsible also for the solution of all the major problems in their plants. They are the men who must work out the organization, management, operation and employment of their shops. In a very real measure these functions and the purchase of equipment are all tied together and must be directed from a central authority if the maximum effective results are to be obtained in production and the great point to keep in mind is that the managers must manage the selection and buying of equipment as well as everything else.

The Industrial Manager

AMERICAN industry is searching for executives and managers. In no other group are there so many openings and opportunities for constructive work as among the men who are directing and controlling industrial enterprises.

But what are the qualifications that distinguish the manager and executive from others engaged in industry?

The function of the executive that is exclusively his is the handling of the human element in production. The man of affairs can supply the money for a manufacturing enterprise; the engineer can design the product, plan the methods of manufacture and design or procure the machinery; and the salesmen can care for the marketing. In the gap between the financier and engineer on the one hand and the salesman on the other stands the industrial executive or manager. He it is who brings about the essential coöperation between labor, materials and machinery. He it is who secures production or output. In so doing he performs a function that is indispensable in any enterprise where a number of persons are engaged, for he directs the living forces and efforts of human beings in industry as opposed to merely controlling the physical forces and natural resources represented in materials and machinery.

Wherever a number of persons are gathered together in a combined industrial effort there the management functions must be exercised. In the smaller concerns one man may suffice to do what must be accomplished; but in the large establishments the management function engages the attention of a whole group.

The great objective of the manager is production. He is concerned with output rather than profit. But not only must he obtain output of the proper quality and in the right quantity with an economical expenditure of materials and time and with an efficient use of the machinery of production under his charge, but above all else he must obtain his output with a reasonable and proper expenditure of human effort. He must not injure the human element. A properly managed enterprise does not get output at the cost of human life or human effectiveness. None of even the humblest industrial group must suffer injury if the management is doing its duty according to present day ideals.

And further, apart from direct injury, output must not be obtained by infringing any human right. A portion of the duties of the manager is to appreciate such rights and safeguard them for all who are under his direction, so that the product for which he is responsible will bear its proper relationship to both the human efforts and the human sacrifices involved.

Manufacturing processes and manual skill are required in all kinds of production. So the manager can well have a profound acquaintance with the technique of the industrial operations that he manages. But this knowledge is also a proper part of the qualifications of a technical engineer. And at this point the distinction between the manager and engineer is seen. The engineer knows the technical side of production; the manager knows the technical side of production and he also knows more. He knows the human element as well. He is an engineer plus; a man possessing the engineer's knowledge and qualifications and others.

For this reason it is perhaps unwise to be too sure that engineers as a great group can pass over into the ranks of industrial executives. Is it fair to assume that a man who has spent half a life time on the technical side of engineering can step at once into managerial duties for which he has had no special training and no direct experience? A negative reply to this question is given by some of our industrial war experiences. There have been case after case where men of affairs have had to step in and supplement the work of their engineers, pointing out to them such essential facts as where and how to procure materials, how to recruit labor, and how to build that most vital thing—the industrial organization. For to create a manufacturing plant, develop it, organize it and start at the actual work of production requires ability and qualifications far broader than those possessed by the average engineer. And it is those qualifications that make the executive and manager stand out from among his fellows.

In the degree that the industrial executive handles the human element in industry has increased his responsibility, not only to the persons who are under him but also to his community. If he catches the vision of his own possibilities for achievement and service he will work out of the fullness of life. The results that he will obtain will be among the finest that humanity has ever produced. How much more worthy it is to influence aright and assist the proper development of human beings, than merely to cut, bend and shape the insensiate materials of production! So the coming place of duty and honor into which the industrial manager is stepping is among the highest in the community.

Welcome! National Association of Employment Managers

A YEAR ago at the first conference called by the National Committee of Employment Managers' Associations discussion was given to the advisability of forming a national association. For a number of reasons the matter was held over and came up for discussion again at the conference just held in Rochester, New York. As the session progressed sentiment crystallized in favor of a national association, a committee was apopinted to develop the plans, and the permanent organization was formed. Without doubt there is a great field of service for this association. The stimulus given by war needs is tremendous and the experience of the national government through the Federal employment agencies brings home the necessity of some organization to assist in working out the broad governmental program in regard to the distribution of employees.

INDUSTRIAL MANAGEMENT is pleased indeed to welcome the new association and wishes for it a long, useful and constructive career.

The New Profession of Employment Management

PERHAPS you have watched through a microscope the forming of crystals from a mother liquor. If so, you have been fascinated by the way the crystals began to shape and then to grow, and had marvelled at their beauty when fully developed.

Some such feeling came to those who were in Rochester, New York, on the days of May 9, 10, and 11, when a new profession crystallized and came into its own at the time of the conference called by the National Committee of Employment Managers' Association. The visiting delegates and their friends first realized that a profession was being born before their eyes when 24 graduates from the first course in employment management given by the University of Rochester marched across the platform of the convention hall to receive their diplomas. That act signifed that a course had been established, that men had enrolled, that the work had been completed and that in full view of every one present honor was being given for worthy accomplishment.

From that time on speaker after speaker emphasized in one way or another the thought that employment management is a profession in its motives and possibilities, a profession that deserves to rank with the law, medicine and engineering, as it is the profession of human relations in industry. Those who enter it and carry it forward to its possibilities will rank among the leaders in the other great fields of industrial effort.

Today there is a most hearty welcome to the members of the new profession—no one resents their coming, many realize the great opportunities before them, all wish them good speed.

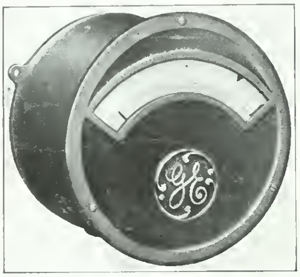
Factory Equipment News

The Latest Labor-Saving Machinery

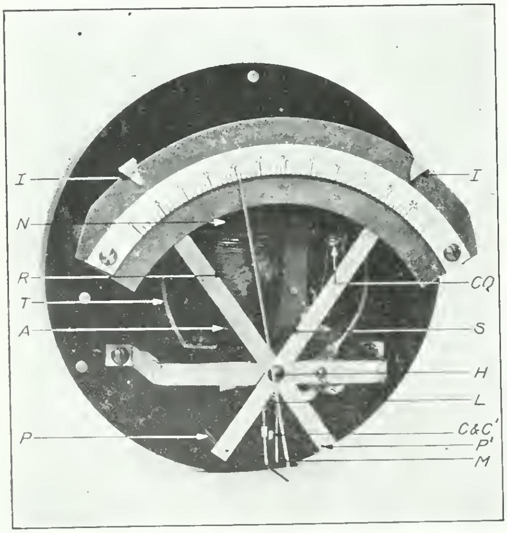
Pressure Governor for Gas and Liquid Systems

THE accompanying illustrations show a new pressure governor designed to control standard self-starters for motor operated pumps and compressors. The governor maintains a pressure between predetermined limits on any gas or liquid systems that will not corrode the Bourdon tube.

In construction the governor consists of a Bourdon tube, an indicating needle, a graduated pressure scale, adjustable high and low pressure stops to determine the desired pressure range, and a relay which actuates the contacts in the control circuit of the self-starter.



GENERAL ELECTRIC COMPANY PRESSURE GOVERNOR



PRESSURE GOVERNOR—INTERIOR VIEW

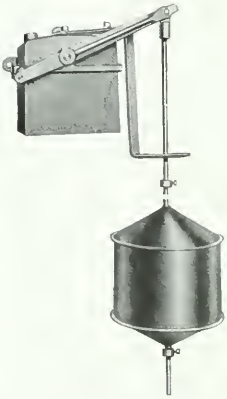
The action of the governor is dependent upon the Bourdon tube, which should be connected to an independent discharge pipe from the pressure tank. The free end of the tube *T* in Figure 2 is mechanically connected to the indicator needle *N*.

Assume that the pressure is at the low level as indicated by the left hand indicator *I*, the contact *C* on the needle *N* completes a circuit through the contact *C'* or the movable arm *M*, which at the low pressure point rests against the stop *P*. When this contact is made, the circuit is completed through the relay coil *R*, causing the armature *A* to close. Attached to this is the contact CO, which upon closing completes the control circuit to the self-starter, causing the motor to start.

The Armature is also attached to the spring *S*, which holds the contact *C'* firmly against *C*, until contact is broken at *P*. As the pressure increases, the needle pointer moves to the right, meanwhile the contact *C* attached to the lower end moves to the left and is followed by the movable arm *M*. When the high pressure point is reached the movable arm is prevented from traveling further by stop *P*, and the needle continues its course, breaking the circuit by separating contacts *C'* and *C*. The instant the circuit is broken the relay *R* is de-energized, its armature falls, releasing the tension of the spring *S*, and because the movable arm *M* is counterweighted it returns to the stop post *P*. When the pressure is decreased to the minimum value the contact *C* again completes the relay coil circuit by engaging contact *C'*, and the cycle of operation is repeated. This governor is a recent product of the General Electric Company, Schenectady, New York.

An Enclosed Float Switch

A FLOAT switch for the remote control of pumps such as are located in basements of power houses and industrial buildings has been developed by the Cutler-Hammer Manufacturing Company, Milwaukee, Wisconsin. It is of the enclosed type, water proof and of a construction intended to withstand abuse and lack of care. A cast-iron case with mounting ears carries all of the operating mechanisms and terminals. A tapped and bushed hole at the top of the case provides an entrance for the conduit. This arrangement permits the removal of the lower enclosure without disturbing the mechanism or the connection.



CUTLER-HAMMER FLOAT SWITCH

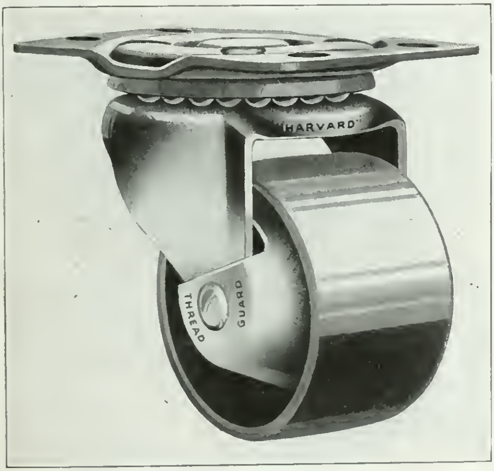
The operating mechanism consists of a cam and roller. The arm carrying the roller is pinned to the main shaft which is turned by the outside cast-iron lever. The cam is made of malleable iron and is cast integral. When the main shaft is rotated the roller is driven up the side of the cam tightening an elliptical spring. When the roller passes the point of the cam the tension of the spring opens or closes the switch. The switch is always open when the roller is one side of the cam, and closed on the other.

In addition to this action of the roller and spring a direct push-out is provided through an auxiliary lever which communicates the motion of the main shaft directly to the cast sleeve which carries and pushes the blades clear of the switch clips. Under normal operation this push-out is not required but becomes effective should the switch tend to stick.

Various mounting and controlling arrangements are furnished. The single pole switches are intended for controlling a. c. or d. c. motors in connection with a starter. The two, three or four-pole switches are designed for single phase, self starting and polyphase squirrel cage motors which may be thrown directly across the line to start. These switches can also be used with direct current motors when used with a suitable self starter.

"Harvard" Ball Bearing Truck Casters

ONE size and style of the line of "Harvard" all steel truck casters made by the Bassick Company, Bridgeport, Connecticut, is shown in the accompanying illustration. The construction throughout is from sheet steel with the exception of the cast iron wheel and the ball bearing. It is intended for use on factory trucks, and the type shown is provided with a guard over the axle to prevent the picking up of thread, lint or other loose material that might catch and wind around the axle. The steel balls used in the bearing are 7/32 inch in diameter.



"HARVARD" TRUCK CASTERS

This type of caster is made in two sizes, one having a wheel 1¾ inch in diameter by 1 1/16 inch face, and the other a wheel 2 inches in diameter by 1 1/16 inch face.

Dravo Tower Whirler

THE accompanying illustration shows a travelling derrick of a type that has been installed in a number of industrial plants and shipyards by the Dravo Engineering Works of Pittsburgh, Pennsylvania.

The whirler is mounted on a travelling tower which may be constructed of either wood or steel. The 10-ton size has a 75-foot boom and can lift a load of 10 tons at a distance of 73 feet from the center at the rate of 200 feet per minute. The 5-ton size has a 55-foot boom and lifts 5 tons at 53 feet from the center at 200 feet per minute. The tower can be constructed from 30 to 50 feet high and travels on its track at the rate of 300 feet per minute. It is mounted on four 28-inch wheels on a 16 to 20-foot gage track.

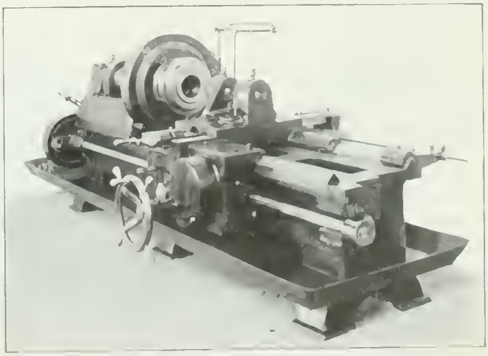
DRAVO TRAVELING DERRICK

The whirler can rotate through 360 degrees in approximately 30 seconds. The boom can be elevated to 80 degrees at speed of 57 degrees in 25 seconds.

In most installations the whirlers are electrically operated, but in some cases where current is unavailable they are driven by steam using oil as fuel. In addition to shipyard installations the whirlers are adapted for use in industrial plants, by railroads and in the handling of bulk material as sand, gravel and crushed stone.

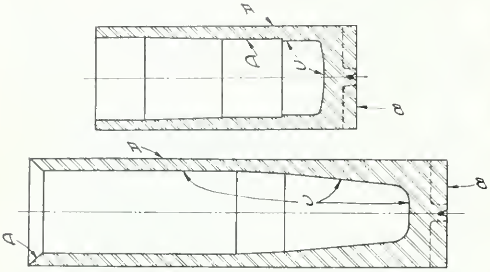
Gisholt Shell Lathe

A HEAVY lathe built primarily for boring shell forgings, but of a type adapted for a wide range of heavy boring, is shown in Figure 1. Outlined cross sections of two shells; one a 155 milli-



GISHOLT SHELL LATHE FOR HEAVY WORK

meter shrapnel and the other a high explosive, are shown in Figure 2. The shorter shell is the shrapnel and the letters C and D indicate the inside boring. Similarly the letter C in the interior of the high explosive shell shows the surfaces to be bored in that type. The surfaces so indicated can be machined on this new lathe, using either the single point cutter in the boring bar with the former block on the taper attachment, or with boring heads located in the boring block and with the cross-slide carriage set central.



SHRAPNEL AND HIGH EXPLOSIVE SHELLS

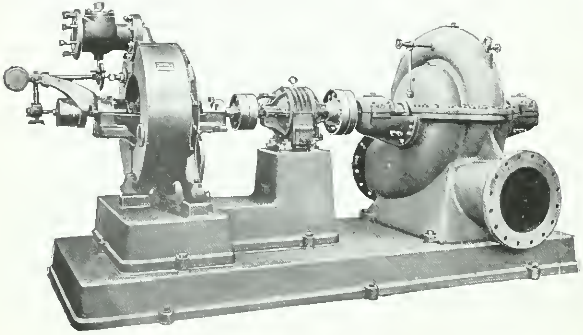
The necessity of rigid design and massive construction have been kept in mind in working out the taper attachment and cross-slide carriage of this machine. The carriage block is bored to three inches in diameter to take heavy boring bars.

The cross-slide carriage bears the entire width of the slide, which is 18 inches, and the slide is 24 inches long. These machines may be arranged to take either a collet chuck, as shown, or a 24-inch three-jaw universal geared scroll chuck, or a four-jaw independent chuck.

This type of machine is made in two sizes: 16 and 25 inch. The 16-inch lathe has a 3¾-inch and 6¼-inch spindle bore, while the 25-inch machines have a 6¼-inch spindle bore. This machine is manufactured by the Gisholt Machine Company, Madison, Wisconsin.

Turbine and Pump Reduction Gear

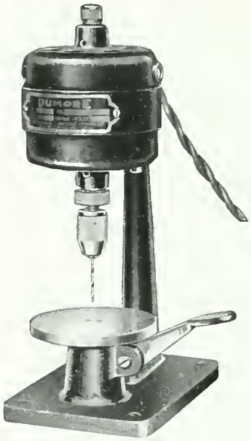
THE accompanying illustration shows a reduction gear developed for direct connection between a high-speed turbine and the centrifugal pump that it drives. Both driving and the driven shafts are in the same straight line. This is a recent development of the Poole Engineering and Machine Company, Baltimore, Md.



POOLE REDUCTION GEAR FOR TURBINE AND PUMP

Portable Electric Grinder

A SMALL, portable, electrically driven grinder, marketed under the trade name of "Dunmore Junior Grinder," has recently been placed on the market by the Wisconsin Electric Company, Racine, Wisconsin. It is adapted for either external or internal grinding. The motor speed is 20,000 r.p.m., permitting the use of very small wheels, and the motor armature is dynamically balanced to eliminate vibration.

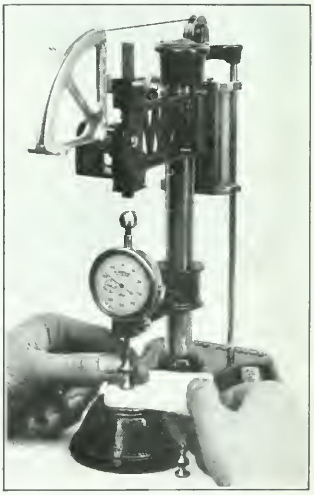


PORTABLE ELECTRIC GRINDER

It is intended especially for use in small machine shops, tool-making shops, garages and the like, where a compact tool is needed and investment in a large grinder is unwarranted.

The Resiliometer

THE resiliometer, a new instrument shown in the accompanying illustration, has just been placed on the market by the Advanced Felt Specialty & Cutting Company, Chicago, Illinois. It is an instrument designed to measure the thickness, hardness and resiliency of any resilient material, as rubber, felt, leather, cork, asbestos, fabrikoids, and all kinds of packing.



THE RESILIOMETER

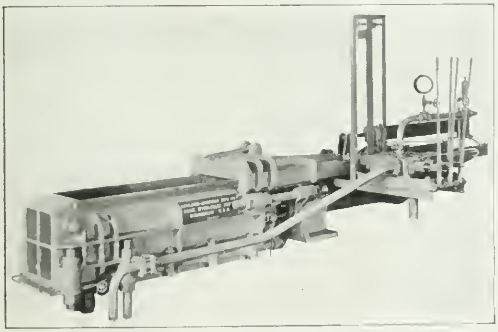
First, it consists essentially of four elements: The anvil on which the material being tested is laid; second, a direct reading micrometer; third, a quadrant actuated by a rack and pinion, which carries the supporting wire for a 2.6 pound weight; fourth, the presser foot which comes in contact with the material and registers directly on the dial by plunger. In use a piece of resilient material is inserted between the bed-plate and the presser foot. As soon as the pressure foot rests securely upon the material, the hand on the dial shows the thickness in thousandths of an inch. When this reading is obtained the weight at the rear running on guide rods is released and allowed to apply pressure upon the material. This causes the presser foot to sink farther into the material until stopped by the natural resistance or hardness of the material itself.

Let us assume that the original thickness was 0.100 inch and the thickness under pressure is 0.05 inch, the hardness of the material—that is, its resistance to pressure—is 50/100, or 50 per cent.; if the original reading had been 72 and the reading under pressure 54, then the material would be 54/72, or 75 per cent. hard.

After the reading under pressure has been taken the weight is lifted off by moving the quadrant shown at the top in front. When this is done the natural resiliency of the material causes the micrometer needle to spring back. The amount of recovery in thousandths of an inch is noted. From this is computed the percentage of resiliency. To illustrate: Suppose that a material registered under pressure a thickness of 0.050 inch, and after the weight is taken off 0.080 inch, then the recovery is 0.30 inch, which is 3/5 of 0.050 inch, or the thickness under pressure, giving us a percentage of resiliency of 60 per cent.

Hydraulic Scrap-Metal Compress

THE illustration shows a hydraulic, scrap-metal compress for use in bundling scrap metals. The compress box is of cast steel accurately machined to give sliding fit to the plunger heads. The purpose of this construction is to avoid the wedging of thin pieces of sheet scrap between the plunger heads and the inside of the box. As an additional protection against this wedging action both the top and bottom of the compress box is V-grooved and the plunger head is likewise grooved to match. The entire inside of the charging box and also the plunger heads are lined with steel plates hardened and readily removable should this become necessary.



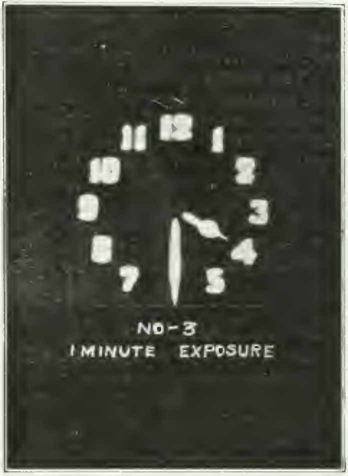
HYDRAULIC SCRAP METAL COMPRESS

After a bundle of scrap has become compressed it is discharged from the machine without the addition of a single moving part. The same operating lever which controls the pressure mechanism removes the final bundle.

The cylinder stuffing boxes are of cast steel providing for ten layers of one-inch square hydro packing. The pressure pistons are ground and polished. The operating valve is the three lever control type and has forged steel cylinders. The plungers are of tool steel packed with ring packing. This machine is a product of the Galland-Henning Mfg. Company, Milwaukee, Wis.

Radium Luminous Material

A RADIUM luminous material in which the principal ingredients are a substance containing radium and zinc sulphide is being marketed under the name of "radium luminous material" by the Radium Luminous Corporation, New York City.



CLOCK FACE FIGURES OF RADIUM LUMINOUS MATERIAL

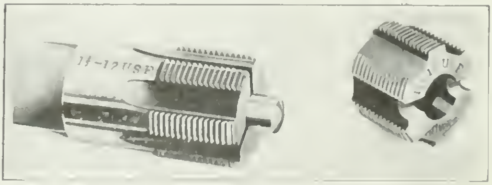
Its principal use up to the present time has been in the manufacture of dials for watches, clocks, boiler-room instruments, automobile and airplane instruments.

The advantages from the use of this material are self-evident as it permits the dial to show in the dark or in places which are not properly illuminated.

The accompanying illustration shows a photograph of a dial treated with radium luminous material in which the photograph was taken through a piece of black paper impervious to light with an exposure for the duration of one minute.

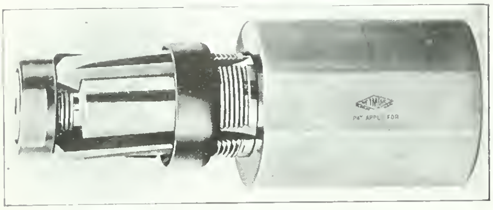
Taps and Reamers for Shell Manufacture

THE accompanying illustration shows taps and an expanding reamer of the floating type for finish sizing the fuse holes of shells. They are



WETMORE MECHANICAL LABORATORY COMPANY TAP recent additions to the line of small tools made by the Wetmore Mechanical Laboratory Company, Milwaukee, Wisconsin.

The expanding reamer shown is made to fit a 3-inch turret hole and designed for finish sizing fuse holes of 155-millimeter United States army shells.



WETMORE EXPANDING REAMER

This reamer floats freely in its socket and is self-centering. The blades are set on a left hand angle to eliminate chatter. Wear of the blades is taken up by means of two expanding ground nuts. The blades may be removed and replaced without taking the tool apart. Each end of the reamer has a true center hole making it possible to grind the blades in place.

The line of taps has been designed from experience gained in making taps for munition contracts, and the details have been chosen for long life and accuracy.

Electric Trucks and Tractors

THE accompanying illustrations show in Figure 1 an electric utility truck for industrial uses and in Figure 2 an electric tractor for the same purposes. They are the products of the Baker R. & L. Company, Cleveland, Ohio.

The utility trucks are provided with a type T enclosed motor wound for 24 volts. Throughout both the motor and on the truck axles annular and thrust ball bearings are used. The axle materials are alloy steels and steel castings. The motor and power axle are placed at the operator's end of the truck to concentrate the weight over the driving wheels and thus increase the traction.

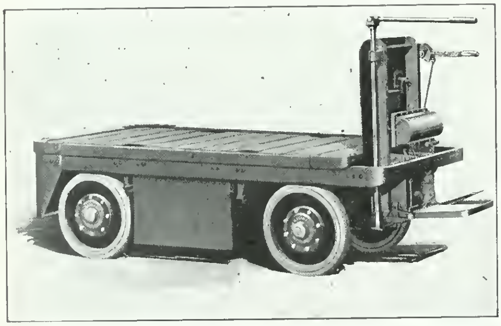


FIG. 1.—BAKER ELECTRIC TRUCK

The batteries are removable from the sides for the purpose of changing or flushing and when in place are provided with water and dirt tight covers.

The controller is of the continuous, drum type mounted in a cast metal housing and operating in oil to insure freedom in the destructive effects of arcing.

The main frame supporting channels have corners and joints fastened with steel corner irons. A steel plate bumper is provided in case the truck is used as a tractor.

The load platform is of wood with its edges protected by steel angles. It can be removed entirely, thus exposing the battery and frame construction.

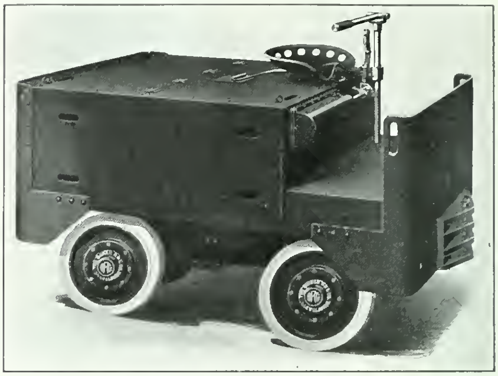


FIG. 2.—BAKER ELECTRIC TRACTOR

These trucks are provided with a fore-wheel steer to give flexibility in handling and a short turning radius. A normal load is 4000 pounds.

The tractor illustrated in Figure 2 is designed for hauling a string of trailers carrying a combined load of perhaps 40,000 pounds.

In general type it resembles the utility truck described above, except that it is made of heavier material to fit it for the work for which it is intended.

The motor is wound for 48 volts and a wide range of battery equipment is offered.

An automatic foot-operated switch is provided, requiring constant foot pressure when operating the tractor. When the driver leaves the tractor, this switch automatically opens the power circuit and applies a motor brake. In addition a foot-operated service brake is located on the motor driving shaft.

Personal and Business Items

Mr. Charles Philip Coleman has recently been elected to the presidency of the Worthington Pump and Machinery Corporation, New York, N. Y.

* * *

Failing health has caused Mr. Dwight S. Cole to discontinue his office as a consulting mechanical engineer and patent attorney, 323 Murray Building, Grand Rapids, Mich.

* * *

The Yarnall-Waring Company, Philadelphia, Pennsylvania, announces that hereafter their power plant accessories will be marketed under the family name of 'Yarway."

* * *

The W. J. Crouch Company, Inc., steel exporters, 253 Broadway, New York, N. Y., have removed its offices to larger quarters, the entire fifteenth floor at 68 William Street, corner Cedar Street.

* * *

The Barrett Company, New York, has recently put out a small booklet in regard to the use of Nox-Aer-Leek cement for preventing infiltration of air through brick boiler-settings.

Mr. Albert Tate Smith, lately manager of the R. U. V. Company, New York City, has returned to the Permutit Company, with which he was formerly connected, to take the position of assistant manager of sales.

* * *

The Electric Machinery Company of Minneapolis, Minnesota, has recently published a 24-page booklet showing the application of their synchronous motors to pumping installations. A prominent feature of the booklet is operating and pumping cost data.

* * *

The Lakewood Engineering Company of Cleveland, Ohio, has recently opened a district office in Milwaukee, Wisconsin, with Mr. Fred T. Kern and Mr. J. N. Young, both formerly of Kern, Hunter, Inc., as its representatives.

* * *

Mr. R. W. Spofford, General Manager of the Augusta-Aiken Railway & Electric Corporation, Augusta, Ga., who is a retired officer of the U. S. Navy, has been called into active service. Mr. W. O. Callaghan succeeds him as General Manager.

* * *

Mr. Paul T. Irvin, who has been associated for twelve years with the Wells Brothers Company, Greenfield, Massachusetts, has recently taken the position of general sales manager of the Lincoln Twist Drill Company of Taunton, Massachusetts.

* * *

Bulletin No. 7 of the Wellman-Seaver-Morgan Company, Cleveland, Ohio, is given over to descriptions of charging machines and manipulators. A number of types are illustrated and described and a partial list of users given.

* * *

Mr. Edward Blake, formerly of Wells Brothers, Greenfield, Mass., has recently been made vice president and general manager of the Lincoln Twist Drill Company, Taunton, Mass. Mr. Frank O. Wells and Mr. Frederick H. Payne are now directors of the Lincoln Twist Drill Company.

* * *

Mr. A. F. Ausman, formerly vice president of the McMaster-Carr Supply Company, Chicago, Ill., has withdrawn from that company and accepted the position of district manager of Nagle Corliss Engine Works, with offices in the Monadnock Block, Chicago, Illinois.

* * *

Mr. Earl E. Adams, lately sales manager of the Powdered Coal Department, Bonnot Company, Canton, Ohio, and for some years in charge of gas producer work for The Power & Mining Machinery Company, has accepted a position as sales engineer for The Smith Gas Engineering Company.

* * *

Mr. A. B. Morrison, Jr., has recently accepted a position with The Smith Gas Engineering Company, Lexington, Ohio, as sales engineer. Mr. Morrison was formerly with the Fort Wayne Electric Works and the Rathbun-Jones Engineering Company, and more recently with the John H. McGowan Company as Philadelphia representative.

* * *

Mr. C. H. Van Hooven, claim agent of the Manilla (P. I.) Electric Railroad & Light Company, who has been visiting the United States on a vacation for the purpose of consulting with officers of The J. G. White Management Corporation, New York, N. Y., the operating managers of the Manila Company, is returning to the Philippines by way of Hawaii and Japan.

The Independent Pneumatic Tool Company, a New Jersey corporation, and the Aurora Automatic Machinery Company have effected a reorganization combining their business under one corporate name. In the future the company will be known as the Independent Pneumatic Tool Company, Inc., of Delaware. Mr. John D. Hurley is president.

* * *

The Ohio Electric & Controller Company, 5900 Maurice Avenue, Cleveland, has been incorporated with a capital stock of $200,000 for the purpose of manufacturing lifting magnets and electrical controlling devices. The officers are: Mr. F. W. Jessop, president; Mr. W. B. Greene, vice-president; and Mr. A. D. Walter, secretary and treasurer.

* * *

The Bogart Company of Philadelphia, Pennsylvania, has just issued a little booklet under the title "Increasing Output by Air-Operated Attachments." It is a talk on some of the form of indirect losses that come from improper gripping and holding devices in the machine shop, and shows the advantages in saving that can be obtained by applying air-operated attachments.

* * *

The Uehling Instrument Company, New York, N. Y., has recently developed a simple straight line chart, which enables any one to estimate quickly the money lost in any chimney due to a low percentage of CO_2. The chart is based on a flue gas temperature of 600 degrees F. and an outside air temperature of 60 degrees F. It has further been assumed that the burned coal has a calorific value of 14,000 B.T.U. per pound of combustible.

* * *

The Lambie Concrete House Corporation, Boston, Massachusetts, has just put out an attractive pamphlet printed in two colors showing concrete homes for workmen. Representative houses are shown taken from three or four industrial communities, the largest group being those built for the American Steel & Wire Company at Donora, Pennsylvania. The Lambie system is fully described, typical floor plans are outlined and a series of views give an excellent idea of the progress of building a house from foundation to roof. This book should appeal especially to manufacturers who are facing the problem of providing industrial houses in their localities.

* * *

The Diamond Power Specialty Company of Detroit, Michigan, has just issued a 48-page bulletin, No. 119, devoted to a review of current practice in the application and use of mechanical soot blowers. This bulletin is very attractive, as it is printed in two colors throughout, contains a wealth of illustrations and much data on boiler room efficiency. It clearly shows the method of cleaning boilers of different types by the Diamond system. A treatise on "insuluminum" is also included. This is a metal with high heat resisting properties and is used for parts of Diamond soot blowers exposed to the hottest places in water tube boilers. Venturi nozzles are also discussed, and tables and graphs give comparative efficiency of nozzles of this type compared with those of other sections. Among other subjects of interest to engineers may be mentioned "Development of Protective Methods for Soot Blowers," "Soot Blowers for Blast Furnace Gas and Waste Heat Boilers," "Soot Blowers for Economizers."

EXPLANATORY NOTE—THE ENGINEERING INDEX

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language,* together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cents. A denotes a price of 40 cents; B, 60 cents; C, 80 cents; D, $1.00; E, $1.20; F, $1.60. The letter N indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

Serial publications are indexed on the appearance of the first installment.

CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of INDUSTRIAL MANAGEMENT at 10 cents per month, or $1.00 a year; to non-subscribers, 25 cents per month, or $3.00 a year.

REFERENCE LIST OF PUBLICATIONS REGULARLY REVIEWED AND INDEXED

ARRANGED IN ORDER OF THEIR ABBREVIATIONS

A A Wkly	Aerial Age Weekly
AERA	AERA
Aeronts	Aeronautics
A I C E	Amer. Institute of Chemical Engineers
A I E E	Amer. Institute of Electrical Engineers
A I M E	Amer. Institute of Mining Engineers
A I Mt	Amer. Institute of Metals
Am Ec Rev	Amer. Economic Review
Am El-Chem Soc	Amer. Electro-Chemical Society
Am Fdymns Assn	Amer. Foundrymen's Association
Am Ir & Stl Inst	Amer. Iron & Steel Institute
Am Jl Pub Hh	Amer. Journal of Public Health
Am Jl Sci	Amer. Journal of Science
Am Mach	Amer. Machinist
Am Rd Blds Assn	Amer. Road Builders' Association
Am Ry Bdge & Bldg Assn	Amer. Railway Bridge & Building Association
Am Soc Ht & Vt Engrs	Amer. Society of Heat. & Vent. Engrs.
Am Soc Mar Dftn	Amer. Society of Marine Draftsmen
Am Soc Nav Engrs	Amer. Society of Naval Engineers
Am Soc Ref Engrs	Amer. Society of Refrig. Engineers
Am Soc Tes Mat	Amer. Society of Testing Materials
Am Wd Pres Assn	Amer. Wood Preserv. Association
Am Wr Wks Assn	Amer. Water Works Association
A R E A	Amer. Railway Engineering Association
A R M M A	Amer. Raliway Mas. Mech. Assn.
Arch For	Architectural Forum
Arch Rec	Architectural Record
A S C E	Amer. Society of Civil Engineers
A S M E	Amer. Society of Mechanical Engineers
Assn Eng Soc	Association of Engineering Societies
Assn I S E E	Association of Iron & Steel Elec. Engrs.
Aus Min Stan	Australian Mining Standard
Auto	Automobile
Autocar	Autocar
Bkn Engs Cb	Brooklyn Engineers' Club
Bos Soc C E	Boston Society of Civil Engineers
Br Rds & Sts	Better Roads and Streets
Brs Wld	Brass World
Bt Fe & Stl Pt	Blast Furnace & Steel Plant
Can Engr	Canadian Engineer
Can Min Jl	Canadian Mining Journal
Can Soc C. E.	Canadian Society of Civil Engineers
Cas Eng Mthly	Cassier's Engineering Monthly
Cen Ry Cb	Central Railway Club
Chem Eng & Min Rev	Chemical Engineering and Mining Review
C E Soc St P	Civil Engineers Society of St. Paul
Cl Age	Coal Age
Colly Gdn	Colliery Guardian
Col Sl Min Mag	Colorado School of Mines Magazine
Col Univ Qly	Columbia University Quarterly
Com Air Mag	Compressed Air Magazine
Com Vhle	Commercial Vehicle
Comwh Engr	Commonwealth Engineer
Concte	Concrete
Contg	Contracting
Contr	Contractor
Corn C E	Cornell Civil Engineer
Cr Min West Aust	Chamber of Mines of West Australia
E Cb Balt	Engineers' Club of Baltimore
E Cb Phila	Engineers' Club of Philadelphia
E Cb St L	Engineers' Club of St. Louis
Econ Geol	Economic Geology
Eff Soc Jl	Efficiency Society Journal
Elec Jl	Electric Journal
Elec'n	Electrician
Elec Rev	Electrical Review
Elec Rev Chi	Electrical Review, Chicago
Elec Ry Jl	Electric Railway Journal
Elec Wld	Electrical World
Eng & Con	Engineering and Contracting
Eng & Min Jl	Engineering and Mining Journal
Eng Ed	Engineering Education
Eng News Rec	Engineering News-Record
Engng	Engineering
Engr	Engineer
Eng Rv	Engineering Review
Engr Soc Penn	Engineers Society of Pennsylvania
Fkn Inst Jl	Franklin Institute Journal
Flying	Flying
Fndry	Foundry
Gen Elec Rev	General Electric Review
Ht & Vtg Mag	Heating and Ventilating Magazine
Ice & Refrig	Ice & Refrigeration
Ill Eng Soc	Illuminating Engineering Society
Imp Inst Bul	Bulletin of the Imperial Institute
Ind Man	Industrial Management
InstAut Engrs	Institute of Automobile Engineers
Inst Rad Engrs	Institute of Radio Engineers
Inst San Engrs	Institute of Sanitary Engineers
Instn C E	Institution of Civil Engineers
Instn E E	Institution of Electrical Engineers
Instn E & S Scot	Inst. of Engrs. & Shpbldrs. of Scot.

Instn Mun & Cnty Engrs	Inst. of Munic. & County Engrs.
Instn Mech Engrs	Institution of Mechanical Engineers
Inst Met	Journal of the Institute of Metals
Instn Min Engrs	Institution of Mining Engineers
Instn Min & Met	Institution of Mining & Metallurgy
Int Mar Eng	International Marine Engineering
Iron Age	Iron Age
Ir & Cl Trds Rev	Iron & Coal Trades Review
Iron Trd Rev	Iron Trade Review
Jl Actcy	Journal of Accountancy
Jl Geol	Journal of Geology
Jl Ind & Eng Chem	Journal of Indust. & Eng. Chemistry
La Eng Soc	Louisiana Engineering Society
La Nat	La Nature
L S Min Inst	Lake Superior Mining Institute
Machy	Machinery
Manr Assn Engs	Manchester Assn. of Engineers
Mfrs Rec	Manufacturers' Record
Mar Eng & Nav Arch	Marine Engineer & Naval Architect
Mar Rev	Marine Review
Mas Boil Mkrs Assn	Master Boiler Makers' Association
M C B A	Master Car Builders' Association
Mech Eng	Mechanical Engineering
Mech Wld	Mechanical World
Met & Chem Eng	Metallurgical & Chemical Engineering
Min Mag	Mining Magazine
Min & Met Soc Am	Mining & Metallurgical Soc. of Amer.
Min & Sci Pr	Mining & Scientific Press
Mun Eng	Municipal Engineering
Mun Engrs Jl	Municipal Engineers' Journal
Mun Jl	Municipal Journal
Nat Assn Corp Schls	National Assn. of Corporation Schools
Nat Engr	National Engineer
Nat Lime Mfrs Assn	National Lime Manufacturers' Association
Nature	Nature
N E C Instn	N-E Coast Institution
N E Rd Cb	New England Railroad Club
N E Wr Wks Assn	New England Water Works Assn.
N Y Dept Labor	New York State Dept. of Labor
N Y Rd Cb	New York Railroad Club
Per-Way Instn	Permanent-Way Institution
Phil Jl Sci	Philippine Journal of Science
Power	Power
Pwr Pt Eng	Power Plant Engineering
Prof Mem	Professional Memoirs
Quarry	Quarry
Roy Un Ser Instn	Royal United Service Institution
Ry Age Gaz	Railway Age Gazette
Ry Cb Pitts	Railway Club of Pittsburgh
Ry Engr	Railway Engineer
Ry Gaz	Railway Gazette
Ry & Loco Eng	Railway & Locomotive Engineering
Ry Mech Engr	Railway Mechanical Engineer
Ry Rev	Railway Review
Ry Sig Engr	Railway Signal Engineer
S A E	Society of Automobile Engineers
Schl Min Qly	School of Mines Quarterly
Sfty Eng	Safety Engineering
Sib Jl Eng	Sibley Journal of Engineering
So Af Inst Engrs	South African Instn of Engineers
Soc Nav Arch & Mar Engr	Society of Naval Arch. & Mar. Engrs.
Soc Pro Sci Man	Soc. to Promote Sci. of Management
S & S W Ry Cb	Southern & Southwestern Railway Club
St L Ry Cb	St. Louis Railway Club
Stev Indic	Stevens Indicator
Stl & Iron	Steel & Iron
Surv'r	Surveyor & Municip. & County Engr.
Tel Engr	Telephone Engineer
Telephony	Telephony
Times Eng Supp	Times Engineering Supplement
Tmwy & Ry Wld	Tramway & Railway World
Univ Col Jl Eng	Univ. Colo. Journal of Engineering
Univ Ill	University of Illinois
Univ Kan	University of Kansas
Univ Minn	University of Minnesota
Univ Mo	University of Missouri
U S Bur Mines	U. S. Bureau of Mines
U S Bur Stds	U. S. Bureau of Standards
U S Dept Ag	U. S. Dept. of Agriculture
U S Geol Surv	U. S. Geological Survey
U S Nat Inst	U. S. Naval Institute
West Eng	Western Engineering
West Ry Cb	Western Railway Club
West Scot I & S Inst	West. Scotland Iron & Steel Inst.
West Soc Engrs	Western Society of Engineers
Wis Engr	Wisconsin Engineer
Worc Poly Inst Jl	Worcester Polytechnic Inst. Journal

The Engineering Index

The following pages form a *descriptive* index to the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world in the English, French, Dutch, Italian and Spanish languages, as far as possible on account of war. The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us. See the Explanatory Note given on the opposite page, where also the full titles of the principal journals indexed are given. This list is subject to change from time to time.

NOTE.—The Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

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INDUSTRIAL MANAGEMENT

EDUCATION

Crippled Soldiers

The Crippled Soldier in Industry (85802 D). Frank B. Gilbreth, with discussion. 4200 w. A I M E, Bul—April, 1918. Investigates the opportunities for such labor and the re-education necessary.

Employment

War Emergency Courses in Employment Department Practice (85900 A). Roy Willmarth Kelly. 2000 w. Ind Man—May, 1918. Programme of intensive training in employment-department practice.

Gisholt System

Training Instructors According to the Gisholt Idea (85730). Fred H. Colvin. 2500 w. Am Mach—April 18, 1918. Serial, 1st part. Principles of a plan for training operators who train other operators.

Human Engineering

Teaching Human Engineering in the College Curriculum (85910). Fred H. Rindge. 4000 w. Am Mach—April 25, 1918. New methods for instructing engineering students.

Laboratory

The National Industrial Research Laboratory (85417 A). Richard T. Glazebrook. Ills. 6500 w. Engng—March 8, 1918. Lecture at Royal Instn. Also editorial. Reviews the history of the National Physical Laboratory, which is to be taken over by the State.

Les Laboratoires Des Usines André Citrœn (85853 C — D). L. Guillet and H. Godfroid. Ills. 7800 w. Revue De Métallurgie—Jan.-Feb., 1918. A splendidly equipped industrial laboratory for researches of all kinds.

Mining Education

Report on Mining Education in England with Special Reference to India (85827 N). G. F. Adams, E. H. Roberton, and Glen George. 107 pp. Min & Geol Inst of India, Trans—Nov., 1917.

Repairmen

Emergency War Training for Gas- engine, Motor-Car, and Motor-Cycle Repairmen (85627 N). 74 pp. Fed Bd Voc Ed, Bul. 10—March, 1918. Outlines courses of instruction.

Secondary Education

La Réforme De L'Enseignment Secondaire (85852 C + D). H. Le Chatelier. 8500 w. Revue De Métallurgie—Jan.-Feb., 1918. Suggestions for improving secondary training.

Training Workmen

Training Workmen for Positions of Higher Responsibility (85801 D). 1600 w. A I M E, Bul—April, 1918. Discussion of F. C. Stanford's paper.

Welders

Training Soldier Welders (85812 A). Ills. 5000 w. Weld Engr—April, 1918. Twenty lectures based on practical instruction at army school at Peoria, Ill.

FINANCE AND COSTS

Accounting

Power Plant Accounting (85387). Thomas G. Thurston. 2000 w. Natl Engr—April, 1918. Actual operating cost known at the end of each day.

American Railroads

The Investment in American Railroads (85431). L. F. Loree. 4000 w. Ry Age—April 5, 1918. What has happened and is happening to invested capital and the relation of the railroads thereto.

Banking

Banking Institutions to Finance Our Future Abroad (85435). Albert Breton. 3500 w. Ry Age—April 5, 1918. Establishing foreign branches not as effective as partnership with separate banks.

The Export Services of the Banks (85444). 2500 w. Ry Age—April 5, 1918. What banks can do to assist the exporter.

Cost Estimating

Comparative Cost Estimating for Designers of Reinforced Concrete Buildings (85297). From paper by Clayton W. Mayers for presentation before Am. Concrete Inst. Ills. 4500 w. Eng & Con—March 27, 1918. Illustrates methods of estimating.

Cost-Records

Uniform Maintenance Cost-Records for Roads Adopted in Washington (85467). George F. Cottrell. 2500 w. Eng News-Rec—April 4, 1918. Rules and requirements of recent legislation.

Costs System

The Organization of an Efficient Foundry Costs System (85680). M. H. Potter. 2200 w. Can Fdman—April, 1918. The costs are reduced to a poundage basis.

Foreign Trade

The Powerful Foreign Trade Combinations of Europe (85448). P Harvey Middleton. 3500 w. Ry Age—April 5, 1918. How to maintain export trade after the war.

Foreign Trade After the War (85541) 2500 w. Am Mach—April 4, 1918. Serial, 1st part. Papers by Guaranty Trust Co of N. Y. on the subject of financial and economic conditions in foreign countries.

Foreign Trade Outlook as Affected by War (85825 A). James A. Farrell. 3000 w. Iron Age—April 25, 1918. Address before the 5th Natl. Foreign Trade Convention. Cincinnati, O. The year's developments in American industry and commerce.

Inventories

Underground Plant Inventories (85599). W. W. Kinsley, Jr. Ills. 3000 w. Telephony—April 13, 1918. Methods and forms: their use and results.

Money Markets

World's Money Markets, Now and After the War (85432). George Paish. 2000 w. Ry Age—April 5, 1918. Wisdom and foresight necessary to meet the situation.

National Finance

The To-morrow of Finance (85658 D). S. N. Patten. 14 pp. An Am Acad—March, 1918. Problems of national finance and how they should be met.

Overhead

See same heading under Street and Electric Railways.

Price Fixing

Value and Price Theory in Relation to Price-Fixing and War Finance (85636 N). B. M. Anderson, Jr. 17 pp. Am Ec Rev—March, 1918. Questions based on developments in price-fixing and the problems.

Railroad Securities

Railroad Security Issues Under Government Operation (85645 D). Thomas Conway, Jr. 10 pp. An Am Acad—March, 1918. Discusses the future of investment.

Rates

Investment Cost Basis for Rates (85921). 2000 w. Telephony—April 27, 1918. Decision of Nebraska Commission in ruling on telephone rate increase.

Taxes

Federal Taxes Upon Income and Excess Profits (85628 N). T. S. Adams, with discussion. 37 pp. Am Ec Rev—March, 1918. Problems and the most promising solutions.

Valuation

Has the Importance of Federal Valuation of Railroads Been Increased or Lessened by Federal Control of Operation? (85647 D). H. B. Whaling. 2000 w. An Am Acad—March, 1918. Considers valuation necessary.

The Federal Valuation of Railroads in Relation to a Definite Policy of National Railway Control (85629 N). John Bauer, with discussion. 28 pp. Am Ec Rev—March, -1918. Considers the present valuation in connection with national control.

See also same heading under Street and Electric Railways.

War Finance

The War Finance Corporation (85437). O. M. W. Sprague. 1600 w. Ry Age—April 5, 1918. Inflation can be prevented only by saving to offset the Government's demands.

War Resources

Making Our Resources Available for War (85433). John E. Oldham. 3000 w. Ry Age—April 5, 1918. Individual responsibility.

Wealth

The Social Control of the Acquisition of Wealth (85635 N). Edward Cary Hayes. 17 pp. Am Ec Rev—March, 1918. Equality of possession not possible or desirable, but excessive differences should be subject to control. Studies the problem.

MANAGEMENT

Bonus

Bonus Plan for Boiler-Plant Operations (85370). Haylett O'Neill. 1500 w. Power—April 2, 1918. Outlines plan whereby firemen, boiler cleaners, fire cleaners may share in savings effected in boiler-room.

Draftsmen

A Psychological Study of Draftsmen (85909). Frank H. Sommers. 2000 w. Am Mach—April 25, 1918. Who should be held accountable for mistakes?

Efficiency

New Problems of Governmental Efficiency (85637 N). A. N. Holcombe. 4000 w. Am Ec Rev—March, 1918. Considers how the purchasing agencies of the government should be organized.

Employment

Employment and the Labor Market (85633 N). Charles B. Barnes. 2500 w. Am Ec Rev—March, 1918. The work of the New York State Employment Bureau, showing the need of coöperation.

Employment Department Organization of Thomas A. Edison Interests (85843 A). Mark M. Jones. 1500 w. Ind Man—May, 1918. How employees are secured and the arrangements for transfers, etc.

Lessons from English War Experience in the Employment of Labor (85631 N). M. B. Hammond. 4000 w. Am Ec Rev—March, 1918. The problems due to war and the ways of solving them. Employment of women and the difficulties, etc.

Problems of Returned Soldiers (85842 A). S. A. Goldsmith. 4500 w. Ind Man—May, 1918. Seeking employment for discharged men at close of war.

Industrial Peace

The Foundation of Industrial Peace (85748 A). A. H. Paterson, with discussion. 7000 w. Roy Soc Arts, Jl—April 5, 1918. Problems and dangers to be met.

Labor

The Human Factor in Modern Production (85818). Alex Ramsay. 5000 w. Cas Eng Mthly—April, 1918. Solution of the conflict between capital and labor.

Let Your Employees See Your Shop (85844 A). B. A. Wack. 1200 w. Ind Man—May, 1918. Suggests a department visiting system showing its benefits.

How to Reduce the Turnover of Labor (85396 A). Ernest C. Gould. 1200 w. Iron Age—April 4, 1918. Methods successfully applied at an Ohio Steel Works.

Your Head Indicates Your Talent (85920). Stanley R. Edwards. Ills. 4000 w. Telephony—April 27, 1918. Character analysis. Study of telephone men.

Labor Shortage

Making Up the Labor Shortage (85901 A). D. N. Crosthwait, Jr. 1400 w. Ind Man—May, 1918. The needs and reserve labor available.

Labor Turnover

The Employment Manager and Labor Turnover Reduction (85800 D). 3000 w. A I M E, Bul—April, 1918. Discussion of Thomas T. Read's paper.

Labor Turnover (85907) Philip Brasher. 4000 w. Am Mach—April 25, 1918. Various phases of the problem are discussed.

Management

Theorieën evaringen over bedrijfsleiding (85855 B). E. Hijmans. Ills. 12,300 w. Igenieur—Feb. 23, 1918. Theory and practice of management in relation to wage systems. Organization and practice in Dutch machine shops.

Methods

Under New Management—From Old to New (85898 A). Charles M. Horton. 3500 w. Ind Man—May, 1918. New attitude of managers illustrating a kindlier feeling toward workers.

Office Methods

Procedure in Office of Construction Engineer, Employing Small Staff, Supervising Expenditure of $2,000,000 for New Improvements (85511 A). H. W. Skidmore. 3500 w. Mun Eng—April, 1918. Field and office methods.

Organization

The Organization of Commercial Intelligence (85514 A). William H. Clark, with discussion. 9500 w. Roy Soc Arts, Jl—March 22, 1918. Outline of the work and aims.

Organization of Government Railroad Administration (85564). 2500 w. Eng News-Rec—April 11, 1918. Chart showing the branches of regional, central and advisory sections, explaining their functions.

A Storekeeping Organization in Russia (85840 A). Percy R. Clark. 1800 w. Ind Man—May, 1918. Convenient forms used where means of communication are primitive, truckmen illiterate and storekeepers poorly educated.

Power Plants

System in the Power Plant (85358). J. C. Hawkins. 2000 w. Pwr Pt Eng—April 1, 1918. Suggestions for increasing efficiency and economy.

Production

Industrial Production (85386 A). William M. Dollar. Abstract of paper before Eng Soc of Buffalo. 4000 w. A S M E, Jl—April, 1918. Elementary principles of increasing production and decreasing cost.

Profit-Sharing

Human Valuation (85896 A). George Kingdon Parsons. 2200 w. Ind Man—May, 1918. Relation of employer and employee, with emphasis on profit sharing.

Scientific Management

Practical Application of Scientific Management (85816 B). 3300 w. Cas Eng Mthly—April, 1918. Describes the practical application of the Taylor system.

Standard Practice

How to Write and Use Standard Practice Instructions in Your Shop (85897 A). Willard S. Worcester. 3000 w. Ind Man—May, 1918. A system of instructions for every department and every operation, for the purpose of saving time and effort.

Superintendents

Shop Stewards (85883). 1200 w. Times Engng Supp—March 29, 1918. A French view of the functions of shop stewards outlined by an English correspondent.

Women Workers

How We Trained 5,000 Women (85837 A). C. U. Carpenter. Ills. 4000 w. Ind Man—May, 1918. Rapid and effective course at Dayton, Ohio for operating machine tools and turning out high precision work.

The Employment of Women in Munition Factories (85526 A). O. E. Monkhouse. 2300 w. Engng—March 22, 1918. The essentials of successful methods of training.

The Problem of Women in War Industry (85846 A). C. E. Knoeppel. 3500 w. Ind Man—May, 1918. The necessity of replacing men called in war service by women.

War Work for Women (85344 A). Luther D. Burlingame. Ills. 5000 w. Machy—April, 1918. Comparison between men and women workers; suitable kinds of work; special methods and equipment; discipline, cost, etc.

See also Employment, and Labor, under Regulation.

REGULATION

Commissions

See same heading under RAILWAY ENGINEERING, *Conducting Transportation.*

Convict Labor

Report on Expermiental Convict Road Camp, Fulton County, Ga. (85420 N). H. S. Fairbank, R. H. Eastham and W. F. Draper. Ills. 64 pp. U S Dept Ag, Bul 583—March 7, 1918. Details of the experiment and results.

Electrical Energy

Government Control of Water Power and Electrical Distribution Abroad (85502). L. W. Schmidt. 3500 w. Power—April 9, 1918. An outline of what has been done in Europe.

Employment

Coördinating of Federal, State and Municipal Employment Bureaus (85630 N). Henry Rogers Seager. 2000 w. Am Ec Rev—March, 1918. Considers the need of developing an adequate federal employment service.

Employment of Labor and the War (85634 N). 16 pp. Am Ec Rev—March, 1918. A general discussion.

Farm Labor

Plan of the Department of Agriculture for Handling the Farm Labor Problem (85632 N). E. V. Wilcox. 5000 w. Am Ec Rev—March, 1918. Explains conditions and gives suggestions for meeting the necessity.

Foreign Workmen

Getting the Foreign Workmen's Viewpoint (85803 D). Prince Lazarovich-Hrebelianovich. 3500 w. A I M E, Bul—April, 1918. Importance of investigating the conditions and environment of the foreign workman in his home lands, and of studying the moral element.

German Trade

World Economics and the Kiel Institute (85707 A). 1000 w. Engr—March 22, 1918. Account of the laying of the cornerstone of the "Institute for Sea Trade and World Economics," and the proposed work of the Institute.

Labor

Adjustment of Labor's Demands During Federal Control of Railroad Operation (85642 D). Glenn E. Plumb. 11 pp. An Am Acad—March, 1918. Rights of capital and of labor in railroad properties.

Labor Laws

Effect of Workmen's Compensation Laws in Diminishing the Necessity of Industrial Employment of Women and Children (85891). Mary K. Conyngton. 160 pp. U. S. Dept Labor, Bul 217—Dec., 1917. Investigation of the effect of workman's compensation laws as compared with employers' liability laws.

Power

Mastering Power Production. V. (85845 A). Walter N. Polakov. Ills. 3500 w. Ind Man—May, 1918. Work to be done before operations can be standardized and tasks set.

Public Utilities

The Public Utilities and the War (85355). Charles W. McKay. 2500 w. Elec Rev, Chi—March 30, 1918. Need of higher rate schedules.

Railroad Laws

Status of Existing Railroad Laws and Regulative Agencies Under Federal Control (85646 D). Edgar Watkins. 1200 w. An Am Acad—March, 1918. Considers regulations to promote competition.

Failures and Possibilities in Railroad Regulation (85638 D). T. W. Van Metre. 4500 w. An Am Acad—March, 1918. A discussion of difficulties and urgent needs in railway operations.

Reconstituting Railroad Regulation (85649 D). George A. Post. 1000 w. An Am Acad—March, 1918. Considers individual initiative and adequacy of revenue essential factors.

Railroad Securities

Desirable Scope and Method of Federal Regulation of Railroad Securities (85653 D). Max Thelen. 10 pp. An Am Acad—March, 1918. The desirable scope and method of regulation.

Rates

How Could Nationalization of Rate Regulation Best Be Accomplished? Martin S. Decker. Also, Legal Questions Involved in Nationalization of Rate Regulation (85656 D). William E. Lamb. 23 pp. An Am Acad—March, 1918. Elements of successful regulation of rates.

Necessity for Exclusive Federal Control Over State and Interstate Rates (85655 D). Edgar J. Rich. 15 pp. An Am Acad—March, 1918. The standard of service must be determined by national authority, and rates must be adjusted with reference to the service.

The Point Now Reached in the Federal Regulation of Interstate Rates (85654 D). J. A. Little. 12 pp. An Am Acad—March, 1918. Reviews the history of federal authority over interstate commerce.

Reconstruction

Address by the Right Hon. Christopher Addison, M. D., M. P., Minister of Reconstruction (85719 N). 15 pp. N E C Instn, Trans—March, 1918. Organization of trades, reconstruction, standardization, etc.

Standardization

Standardized Occupations and Rates (85899 A). W. D. Stearns. 1800 w. Ind Man—May, 1918. Methods adopted by the Westinghouse Electric and Manufacturing Co.

State Regulation

State Regulation of the Securities of Railroads and Public Service Companies (85652 D). Mary L. Barron. 24 pp. An Am Acad—March, 1918. Powers and procedure of public service commissions in relation to security issues of public service corporations.

WELFARE AND SAFETY

Feeding Employees

A Dietary for Miners (85474). S. H. Brockunier. 3000 w. Eng & Min Jl—April 6, 1918. Food rations and methods of food storage and preparation.

Housing

Feeding and Housing Railway Maintenance of Way and Construction Employees (85704). 4500 w. Eng & Con—April 17, 1918. Study of methods of various railways, made by sub-committee of Am. Ry. Eng. Assn.

Welfare and the Housing Problem (85819 B). W. G. Cass. 2500 w. Cas Eng Mthly—April, 1918. Considers housing conditions of the working classes.

See also same heading under Civil Engineering, *Construction.*

Industrial Health

Illness in Industry—Its Cost and Prevention (85799 D). 3000 w. A I M E, Bul—April, 1918. Discussion of Dr. Thomas Darlington's paper.

Labor

Human Problem Thought of Paramount Importance in Paris Shrapnel Plant (85913). Robert K. Tomlin, Jr. 2000 w. Eng News-Rec—April 25, 1918. Health of 6,000 women employees safeguarded.

Mine Accidents

Mine Labor and Accidents (85798 D). 3000 w. A I M E, Bul—April, 1918. Discussion of Herbert M. Wilson's paper.

R. R. Y. M. C. A.

Remarkable Progress Being Made by R. R. Y. M. C. A. (85450). John F. Moore. Ills. 4000 w. Ry Age—April 5, 1918. Service in war work.

MISCELLANY

Engineers

Engineering Prestige (85808). R. O. Wynne-Roberts. 9000 w. Can Engr—April 18, 1918. Survey of what can be done to improve the welfare and national status of engineers.

The Engineer in the New Democracy (85814 B). George C. Whipple. 20 pp. Bos Soc C E, Jl—April, 1918. The place of engineers in the war and what will come after. Address of retiring president.

Reconstruction

British Reconstruction Plans (85540). Robert P. Skinner. 4000 w. Am Mach—April 4, 1918. Tells of plans being made by British to meet after-war conditions.

MECHANICAL ENGINEERING

AERONAUTICS

Aeroplanes

L'Évolution De L'Aviation Allemande (85871 B). J. A. Lefranc. Ill. 5600 w. La Nature—March 16, 1918. Comprehensive review of different German motors.

The Use of Spruce in Aeroplane Construction (85367). J. A. Newlin. 1200 w. A A Wkly—April 1, 1918. Data obtained by the Forest Products Laboratory.

Air Fighting

Tricks Necessary in Air Fighting (85397 A). Granville A. Pollock. Ills. 2500 w. Flying—April, 1918. Tricks that save a pilot and tricks that kill him.

Anti-Aircraft

Il Problema Del Tiro Antiaereo (85873 C+D). G. Fioravanzo. 10,400 w. Rivista Marittima—Dec., 1917. Considerations governing the problem of anti aircraft gun fire.

Biplane

The Albatros Type "CV" Fighter (85482). Ills. 2000 w. A A Wkly—April 8, 1918. Serial. 1st part. Interesting features.

The C. IV. Rumpler Biplane (85366). Ills. 1000 w. A A Wkly—April 1, 1918. A general utility enemy machine of great speed.

British Policy

Points in British Air Policy (85485). 5500 w. Auto Ind—April 4, 1918. Requirements to maintain efficiency.

Dirigibles

I Dirigibili Forlanini (85870 B). Ills. 4500 w. L'Industria—Feb. 28, 1918. New Italian dirigible embodying novel features.

Engines

Engine Weight (85483). F. W. Lanchester, in Flying (London). 1500 w. A A Wkly—April 8, 1918. Gives diagram for comparing two engines and calls attention to results obtained.

Opposition to Liberty Engine Due to Interests in Other Types (85726). 2500 w. Auto Ind—April 18, 1918. Reports 264 liberty engines now in service.

See also Engines, under Automobiles.

Flying

Reminiscences of Early Flight (85918 B). E. W. Roberts. Ills. 3000 w. S A E, Jl—April, 1918. Account of flight made with the Maxim steam-powered machine in 1894.

Hydroplanes

Curtiss Granted Flying Boat Patents (85481). Ills. 4000 w. A A Wkly—April 8, 1918. Specifications and claims.

Laboratory

Aerodynamic Laboratory of the Leland Stanford Junior University (85381 B). William F. Durand. Ills. 4500 w. S A E, Jl—March, 1918. Taken from Part I. of Report No. 14 of the National Advisory Committee for Aeronautics, Washington. Experimental investigations.

Lafayette Escadrille

How the Famous Lafayette Escadrille Was Started (85398 A). Elliott C. Cowdin. Ills. 1500 w. Flying—April, 1918. Interesting account.

Minimum Wage

The Minimum Wage (85882). 2200 w. Times Engng Supp March 29, 1918. Discussion of the question, the ultimate aim, etc.

Standardization

Current Standardization Work (85383 B). Ills. 2000 w. S A E, Jl—March, 1918. Outline of work at recent meetings of the Aeronautic and Marine Divisions of the Standards Committee.

Wind Tunnels

Design and Use of Wind Tunnels (85382 B). J. R. Pannell. 10,500 w. S A E, Jl—March, 1918. From paper before Aeronautical Society of Great Britain. Types, developments in different countries and related topics.

AUTOMOBILES

Bearings

Some Fundamentals of Rolling Support (85376 B). F. W. Gurney, with discussion. Ills. 4000 w. S A E, Jl—March, 1918. Ball vs. roller bearings, construction, difficulties, etc.

Bodies

Automobile Body Design and Construction (85917 B). E. W. Goodwin, with discussion. 7000 w. S A E, Jl—April, 1918. Influence of chassis design; seating; details of construction, etc.

Drivers

War Truck Driver Qualifications (85484). W. F. Bradley. Ills. 1800 w. Auto Ind—April 14, 1918. Military training essential.

Engines

Car and Aircraft Engines (85515 A). Ills. 2000 w. Autocar—March 16, 1918. Extent to which car engine design will be affected by aero engine developments. Comparison between the features of the two types.

France

French Automobile Industry After the War (85725). G. Lumet. 2200 w. Auto Ind—April 18, 1918. Questions to be solved in relation to the industry.

Fuels

Fuels for Tractor Engines (85379 B). J. L. Mowry, with discussion. 3500 w. S A E, Jl—March, 1918. Engine production and operation; field observations; possible fuels and conclusions.

Headlights

Headlight Illumination Requirements (85727). Ills. 2000 w. Auto Ind—April 18, 1918. Tests made to determine minimum illumination required and maximum glare tolerable.

Lubrication

Tractor Engine Lubrication and Lubricating Oils (85728). W. G. Clark. 5000 w. Auto Ind—April 18, 1918. Tests carried out to determine suitable oils for a particular engine.

Magnetos

Pole Pieces for Magnetos (85729). Fred I. Hoffman. Ills. 1200 w. Auto Ind—April 18, 1918. Unusual shapes given the pole tips with the object of widening the peak of the voltage curve and insuring a hot spark for starting when the spark is retarded.

Military Trucks

Military Motor Trucks in the Great War (85919 B). H. L. Horning. 1500 w. S A E, Jl—April, 1918. Argument for standard trucks.

Motor Fuel

Alcohol As a Motor Fuel (85821). J. E. MacCormick. 3000 w. Pr House—March, 1918. Serial. 1st part. Shows that alcohol cannot compete with gasoline.

Motor House

The Ideal Motor House (85517 A). Ills. 1200 w. Autocar—March 23, 1918. Suggestions as to requirements of the owner-driver.

Motor Trucks

Motor Trucks in War and Commercial Service (85378 B). G. W. Smith. 2000 w. S A E, Jl—March, 1918. Changes desirable for required service.

Varied Uses of Motor Trucks Bring Bigger Profits to Enterprising Farmers (85457 A). Ills. 2000 w. Com Vhle—April 1, 1918. Motorized equipment essential to success in coming season.

Requirements

Present Requirements of the Automobile User (85377 B). J. Edward Schipper, with discussion. 4500 w. S A E, Jl—March, 1918. Demands for performance, appearance, reliability, economy, etc.

Sedan

Staggered Door Sedan (85601). George T. Mercer. Ills. 1500 w. Auto Ind—April 11, 1918. Details of a suggested design.

Starting

Effects of Low Temperatures on Starting (85380 B). 3500 w. S A E, Jl—March, 1918. Discussion at Cleveland section meeting.

Tractors

Demonstration of Tractors and Ploughs in Scotland (85528 A). 4500 w. Engr—March 15, 1918. Account of tests.

Trucking

Cleveland Overland Truck Haulage Concern Serves Sandusky, Akron and Canton (85455 A). Ills. 2500 w. Com Vhle—April 1, 1918. Account of service rendered.

Motor Truck Rural Express Routes in Maryland Increase Vital Food Production (85458 A). Ills. 2000 w. Com Vhle—April 1, 1918. Twenty-three routes, with thirty-one vehicles in use.

Universal Joints

Flexible Fabric Universal Joints (85375 B). C. A. Schell, with discussion. Ills. 5000 w. S A E, Jl—March, 1918. Construction, use, etc.

Women Drivers

Women Drivers and Service Cars (85516 A). Ills. 1500 w. Autocar—March 16, 1918. Details of the work performed.

COMBUSTION MOTORS

Diesel Engines

Development of the Diesel Type Marine Heavy Oil Engine in the United States (85589 A). George A. Colley. 2500 w. Int Mar Eng—April, 1918. A resumé of what has been accomplished and what is necessary to compete with steam.

HEATING AND COOLING

Air Tests

Test of Air Conditions in the Wholesale Tailoring Establishment of the John Gorman Company (85718). John Howatt. Ills. 2500 w. Ht & Vt Mag—April, 1918. Explains conditions of a shop in Chicago, giving results of tests.

Fuel

Possibilities of the Relief of Fuel Consumption in Canadian Industry by the Increased Use of Hydroelectric Energy (85365). J. M. Robertson. 2500 w. Can Engr—March 28, 1918. Read before Can. Soc. of Civ. Engrs.

The Gas Industry and Canada's Fuel Problem (85364). Arthur Hewitt. 2500 w. Can Engr—March 28, 1918. Abstract from paper before Can. Soc. of Civ. Engrs. Gas as fuel for industrial purposes.

Heating Dwellings

How 20 Per Cent. of the Cost of Heating Buildings Can Be Saved (85299). 800 w. Eng & Con—March 27, 1918. Suggestions sent by the Colo. State Council of Defense to householders for the proper use of coal.

Refrigeration

Comparative Merits of Refrigerating Systems (85390). 7000 w. Natl Engr—April, 1918. Discussion on the relative merits of the absorption and compression methods of mechanical refrigeration by operating engineers in New York City.

Economy of the Refrigeration Power Plant (85311 B). Victor J. Azbe. Curves. 20 pp. A S R E, Jl—Jan., 1918. A study of gains and losses.

Heat Balance of the Ammonia Compression System (85310 B). J. H. H. Voss, with discussion. Ills. 22 pp. A S R E, Jl—Jan., 1918. Discusses the three values for determining the economy of the ammonia compression system.

Synchronous Motors for Driving Ammonia Compressors (85312 B). Truman Hibbard. 2800 w. A S R E, Jl—Jan., 1918. Advantages as compared with the induction motor.

The Machinery of Refrigeration (85849 A). Charles L. Hubbard. Ills. 3000 w. Ind Man—May, 1918. Principles of refrigeration; systems in use; power required, applications, etc.

Tunnel Ventilation

The Proposed New Jersey-New York Vehicular Tunnel (85717). Maps and Ills. 2500 w. Ht & Vt Mag—April, 1918. How the problem of ventilation will be solved in the new highway under the Hudson River.

HYDRAULIC MACHINERY

Pumping Engines

Triple-Expansion Pumping Engines for the London County Council (85760 A). Ills. and Plate. 1200 w. Engng—April 5, 1918. Serial. 1st part. Centrifugal pumping plant recently installed at one of the sewage-pumping stations.

MACHINE ELEMENTS AND DESIGN

Bearings

Ball Bearings for Electric Motors (85544). A. H. MacCaffray. 1700 w. Am Mach—April 11, 1918. Ideas in regard to their use.

Gears

Industrial, Mill or Job Gearing—To What Extent Can It Be Standardized? (85545). Frank Burgess. 3000 w. Am Mach—April 11, 1918. Subject of gear standardization discussed.

Reduction Gear

Steam Turbine Reduction Gear (85519 A). Ills. 1000 w. Mech Wld—March 22, 1918. Serial. 1st part. Chief points and methods adopted in determining the principal stresses and correct proportions.

Screw Threads

Screw Thread Commission (85395 A). 1500 w. Iron Age—April 4, 1918. Important bill before the House to establish a national standard.

Springs

A New Theory of Plate Springs (85723 B). David Landau and Percy H. Parr. Ills. 26 pp. Fkn Inst, Jl—April, 1918. Serial. 1st part. Account of research work and the new theory developed.

MACHINE WORKS AND FOUNDRIES

Annealing

Annealing by Muffle and Pot Ovens Compared (85402). Joseph B. Deisher. Read before Am. Fndry. Assn. 5000 w. Fndry—April, 1918. Carbon losses by these two methods are discussed, giving test results.

Appliances

Templets, Jigs and Fixtures (85534 A). Joseph Horner. Ills. 3300 w. Engng—March 15, 1918. Serial. 1st part. Explains the usefulness of these aids to machining, and the difficulties.

A Combined Milling Fixture and Drilling Jig (85687 A). Ills. 700 w. Mech Wld—April 5, 1918. Description and use.

Brass Furnaces

Brass Furnace Practice, Some Problems and Suggestions (85777). Charles Vickers. Ills. 2500 w. Brs Wld—April, 1918. Types—particularly the Goldberger furnaces.

Brass Melting

Gas for Brass Melting (85779). Charles C. Krausse. Ills. 2000 w. Brs Wld—April, 1918. Details in designing furnace; burners; gas consumption, etc.

Castings

Castings of Admiralty Bronze (85692 A). H. C. H. Carpenter and Miss C. F. Elam. Ills. 2500 w. Engng—March 29, 1918. Serial. 1st part. Read before the Inst. Metals. An investigation on unsound castings: the cause and the remedy.

Copper Castings for Electrical Purposes (85712 A). G. F. Comstock. Ills. 1500 w. Iron Age—April 18, 1918. Use of silicon as a deoxidizer insures maximum electrical conductivity.

How Iron Castings for Big Gun Lathes Are Made (85401). H. Cole Estep. Ills. 2200 w. Fndry—April, 1918. Castings for some of the largest machine tools ever built.

Machining Operations on the Backbone of the Fordson Tractor (85600). J. Edward Schipper. Ills. 2500 w. Auto Ind—April 11, 1918. Operations on a 198-lb. casting.

Making Hand Grenade Castings for Uncle Sam (85407). A. M. Jones. Ills. 1500 w. Fndry—April, 1918. Practice of a Milwaukee malleable iron plant that is producing 18000 grenades daily.

Coloring Metals

Approved Practice in Coloring and Lacquering (85778). James Steelman. Ills. 4500 w. Brs Wld—April, 1918. Serial. 1st part. Coloring effects, coatings, japanning, etc.

Cores

Producing Small Cores Cheaply in Quantities (85406). R. E. Kennedy. Ills. 5500 w. Fndry—April, 1918. Recommends the employment of women in core rooms.

Cupolas

Overcoming Troubles in Cupola Operation (85548 A). Paul R. Ramp. 3300 w. Iron Age—April 11, 1918. Suggestions on cupola practice.

Die-Casting

Die-Casting of Aluminum-Bronze (85525 A). H. Rix and H. Whitaker. Ills. 2500 w. Engng—March 22, 1918. Advantages and methods.

Drafting-room

Business Methods in the Drafting-room (85346 A). Edward K. Hammond. Ills. 4000 w. Machy—April, 1918. Advantages of standardization in maintaining blueprint files, practice followed, etc.

Drilling

Speeds and Feeds for Drilling (85348 A). Edward K. Hammond. Ills. and Tables. 4500 w. Machy—April, 1918. Methods of determining proper conditions of operation. Effect of high speed on efficiency.

Factory Lighting

Lighting Curtailment in the Industries (85476). A. L. Powell. 2000 w. Elec Wld—April 6, 1918. Adequate lighting essential to safety and to maximum production.

Fly-wheels

Elements of Fly-Wheel Design from the Standpoint of Graphics (85520 A). Ewart S. Andrews. 1200 w. Mech Wld—March 22, 1918. Serial. 1st part. A study.

Forging

Machine Forging (85688 A). D. M. Caird. From paper read before the Manchester Assn. of Engrs. 1800 w. Mech Wld—April 5, 1918. Serial. 1st part. Compares British and American methods in manufacturing rivets, methods of forging, etc.

Furnaces

Furnaces for Munitions (85878). 2300 w. Times Engng Supp—March 29, 1918. Characteristics of heating furnaces for shell billets; annealing furnaces, etc.

Fuses

Loading and Assembling Time Fuses (85342). G. C. White. Ills. 5800 w. Machy—April, 1918. Complete equipment of a fuse loading and assembling plant, explaining how a fuse operates.

Guns

The Erosion of Guns (85791 D). Ills. 1100 w. A I M E, Bul—April, 1918. Discussion of Henry M. Howe's paper.

The Relining of Guns at the Watervliet Arsenal (85906). E. A. Suverkrop. 4500 w. Am Mach—April 25, 1918. Said to be the first published description of this important war economy. Methods employed. Serial. 1st part.

Handling Devices

See same heading under Transporting and Conveying.

Lathes

New Design of High-Power Double-Acting Lathe Adapted for Machining Axle Forgings (85423 A). Ills. 1000 w. Ry & Loco Eng—April, 1918. Recently placed on the market by the Niles-Bement-Pond Co.

Laundry Machinery

Recent Steam Laundry Machinery (85757 A). Ills. 2500 w. Engr—March 29, 1918. Latest types, developed as a result of war demands.

Machine Tools

Machine-Tool Exports After the War (85543). Ludwig W. Schmidt. 2500 w. Am Mach—April 11, 1918. Suggestions for securing and maintaining a market.

Machining

Machining Adjusting Collars (85731). W. G. Groocock. 2000 w. Am Mach—April 18, 1918. Discussion of jig design and suggestions.

Mechanical Drawing

Mechanical Drawing and Sketching for Operating Engineers (85391). Ferrell Croft. Ills. 3000 w. Natl Engr—April, 1918. Representation of different forms of screw threads.

Melting

Melting Metals (85685 A). Walter J. May. 2500 w. Mech Wld—March 29, 1918. Suggestions for proper melting practice.

Milling Machine

Continuous Milling Machine (85415 A). Ills. 1000 w. Engng—March 8, 1918. Machine built in Mass., U. S. A., designed for continuous operation of the cutters.

Molding

Results of Use of Permanent Molds in England (85405). 1800 w. Fndry—April, 1918. French mortar bombs were made by this method but have been discontinued and are now made in sand.

Munitions

Birmingham and the Production of Munitions (85758 A). 3500 w. Engr—March 29, 1918. Serial. 1st part. The conversion and erection of factories and information gained on a visit of inspection.

Savings on Rifle and Munitions Contracts (85711 A). 1800 w. Iron Age—April 18, 1918. The cost-plus plan as applied in the Ordnance Department to reduce government outlay on war work.

The Birmingham Munitions Area (85691 A). 6000 w. Engng—March 29, 1918. Serial. 1st part. The important work being done to supply the needs of the army.

Nomography

Nomography, with Special Reference to Its Use in Engine Design (85701 N). F. Leigh Martineau and A. Marshall Arter. Ills. 40 pp. Instn Auto Engrs—March, 1918. The practical side of the question.

Patterns

Systematic Storage of Patterns (85817 B). Ills. 1200 w. Cas Eng Mthly—April, 1918. Details of an up-to-date system.

Planing Machines

Metal Planing Machines of Concrete (85394 A). Charles Lundberg. Ills. 2000 w. Iron Age—April 4, 1918. Manner of constructing the huge planing machines to machine beds of gun boring machines.

Making Concrete Metal-Planing Machines (85542). Ethan Viall. Ills. 900 w. Am Mach—April 11, 1918. Machines made from reinforced concrete.

Repair Shops

A Southwestern Repair Shop (85539). Frank A. Stanley. Ills. 2000 w. Am Mach—April 4, 1918. Methods used in overhauling mining and railroad equipment.

Riveting

Pneumatic Riveting Practice (85349 A). A. Mason MacFarland. Ills. 7500 w. Machy—April, 1918. Different types of tools and machines, their use, abuse, maintenance and repair.

Screw Threads

Thread Rolling (85345 A). Franklin D. Jones. Ills. 6000 w. Machy—April, 1918. Serial. 1st part. Methods, various types of thread rolling machines and advantages and general application.

Shop Practice

Efficient Pattern Shop Methods That Save Time (85404). J. H. Gard. Ills. 1000 w. Fndry—April, 1918. Novel method of producing a hopper pattern, and cheaply made gear and pulley models.

General Work in the Small Shop (85518 A). Ills. 1800 w. Mech Wld—March 22, 1918. Serial. 1st part. Articles intended to benefit men in small shops with limited facilities.

Bending and Drilling Tubes, Angles and Flat Sections (85908). Frank A. Stanley. Ills. 3000 w. Am Mach—April 25, 1918. Interesting features of a factory engaged in work made from tubing.

Sensitive Drilling Machine Spindle Construction (85347 A). Charles F. Bernitt. Ills. 4000 w. Machy—April, 1918. Development and features of design.

Two Short Operations Better Than One Long One (85841 A). Aldabert R. De Kuzelewski. 1000 w. Ind Man—May, 1918. Suggestion for expediting work based on shop experience

Shop Problems

A Press-Made Clip (85428 A). G. W. Smith. Ills. 1000 w. Mech Wld—March 15, 1918. Describes necessary tools and methods.

Tool-Rooms

Efficient Tool-Room System (85709 A). 1200 w. Iron Age—April 18, 1918. Method used in shop of Kempsmith Mfg. Co., Milwaukee. Centralized grinding and systematized collection and delivery of cutting tools.

Welding

Electric Arc Welding Applied to Cast Iron (85403). B. W. Bowers. Ills. 1800 w. Fndry—April, 1918. Methods applied.

MATERIALS OF CONSTRUCTION

Alcohol

Alcohol from Sulphate-Pulp Waste Liquor (85362 A). Ellwood Hendrick. Ills. 1200 w. Met & Chem Eng—April 1, 1918. Plant of the W. Va. Pulp & Paper Co., at Mechanicsville, N. Y.

Alloys

Occluded Gases in Ferrous Alloys (85722 B). Gellert Alleman and Charles J. Darlington. Ills. 20 pp. Fkn Inst, Jl—April, 1918. Research work and conclusions.

On Lead-Tin-Antimony Alloys (85538 A). O. W. Ellis. 700 w. Engng—March 15, 1918. Read before Inst of Metals, London. Investigations.

The Constitution of the Copper Rich Aluminum-Copper Alloys (85535 A). J. Neill Greenwood. Ills. 6000 w. Engng—March 15, 1918. Serial. 1st part. Account of research work.

Bronzes

Worm Gear Bronzes (85916 B). W. M. Corse. Ills. 2500 w. S A E, Jl—April, 1918. Brief review of the history of bronze and a study of the metallurgy of bronzes.

Hardening

The Hardening and Tempering of Steel (85418 A). C. A. Edwards. Read before the Manchester Assn. of Engrs. Ills. 4400 w. Engng—March 8, 1918. Considers treatment of carbon steels and special steels.

Hardness

Brinell Test of Hardness (85430 A). Fairfax. 1200 w. Mech Wld—March 15, 1918. Preparation of samples and methods of testing.

Joints

Joints and Jointing Materials (85305). 3500 w. Engr—March 8, 1918. Considers plastic, sheet and metallic joints.

Sands

Molding Sands, Facing Sands and Blackings (85686 A). S. G. Smith. 1800 w. Mech Wld—March 29, 1918. Serial. 1st part. Their composition, requirements, etc.

Sulphuric Acid

Calumet & Arizona Sulphuric-Acid Plant (85373). Courtenay De Kalb. Ills. 4000 w. Min & Sci Pr—March 30, 1918. Outline of process of acid manufacture, etc.

MEASUREMENT

Air Compressors

Testing an Air Compressor (85496). Walter S. Weeks. Ills. 1700 w. Min & Sci Pr—April 6, 1918. Volumetric efficiency by orifice test; illustrative examples and charts.

Crushing Strength

Crushing Strength of Magnesia-Silica Mixtures at High Temperatures (85836 N). O. S. Kowalke and O. A. Hougen. Ills. 2000 w. Am El-Chem Soc—April-May, 1918. Investigations, describing apparatus used and explaining theory.

Ductility

Erichsen Tests on Aluminum Sheets (85549 A). Robert J. Anderson. 1200 w. Iron Age—April 11, 1918. How this method is applied to determine ductility and regulate annealing.

Graphical Methods

Graphical Methods of Finding Centres of Gravity and Resultants (85429 A). W. W. Padfield. 1000 w. Mech Wld—March 15, 1918. Serial. 1st part. Method described and illustrated by examples.

Laboratories

Standardization of Rare-Metal Thermocouples (85359 A). Paul D. Foote, T. R. Harrison and C. O. Fairchild. Ills. 5000 w. Met & Chem Eng—April 1, 1918. First of two articles dealing with the pyrometer laboratory for industrial purposes.

Permeability

The Measurement of the Permability of Iron Stampings by Ewing's Double Bar and Yoke Method (85683 A). Frank Shaw. Ills. 3000 w. Elec'n—March 22, 1918. Experiments undertaken to demonstrate the applicability of Ewing's method to the determination of the permeability of laminated specimens of steel.

Power Measurement

Torsion Meter for Power Transmitted by Propeller Shafts (85400). Ills. 2500 w. Mar Eng, Can—March, 1918. Apparatus found satisfactory in measurement of power developed by marine engines.

Screw Threads

Projection Method of Testing Screw Threads (85351 A). Franklin D. Jones. Ills. 2800 w. Machy—April, 1918. Projection apparatus as applied to inspection of thread gages for munitions manufacture.

Shafts

Whirling and Whip of a Revolving Shaft (85533 A). G. Greenhill. 3000 w. Engng—March 15, 1918. Serial. 1st part. States the problem and method of investigating, explaining theory.

Speedometer

A Liquid Speedometer (85309 N). William Alexander, with short discussion. Ills. 3500 w. So Af Instn Engrs, Jl—Feb., 1918. Detailed description of the instrument, explaining its advantages.

Steam Testing

Testing Quality of Steam (85388). W. A. Taller. Ills. 2500 w. Natl Engr—April, 1918. Simple methods of attaching calorimeter and making moisture determinations.

Stresses

Twisting and Bending Moments in Square and Rectangular Bars (85343 A). Victor M. Summa. 300 w. Machy—April, 1918. Derives formulas.

POWER AND TRANSMISSION

Lubrication

Air-Compressor Lubrication (85689 A). From *Lubrication*. 2500 w. Mech Wld—April 5, 1918. External and internal lubrication, characteristics of lubricants, methods of applying oil, etc.

Power

See same heading under INDUSTRIAL MANAGEMENT, *Regulation*.

STEAM ENGINEERING

Boilers

Stoker Capacity vs. Boiler Forcing Rates (85781). Joseph T. Foster. 1500 w. Power—April 23, 1918. Ways to check boiler performance against any well-defined standard and ascertain what improvements changes will effect.

Combustion

Combustion Characteristics of Coals and Selection of Suitable Stoker Equipment (85410 A). Joseph G. Worker. Ills. 2500 w. Elec Jl—April, 1918. Available coals in United States and tests of stokers.

Efficient Combustion of Bituminous Coal With Underfeed Stokers (85847 A). Russell C. Hine. Ills. 2000 w. Ind Man—May, 1918. Improved methods of firing soft coal. Points to be looked after.

Unpreventable Losses in Coal Combustion Under Boilers (85501). Haylett O'Neill. 500 w. Power—April 9, 1918. Calculations showing their magnitude. Charts are given.

Feed Water

Testing and Treating Power Plant Feed Water (85773). Hartley LeH. Smith. 3000 w. Elec Ry Jl—April 20, 1918. Careful analysis and judicious use of chemicals necessary.

Fuels

Power from Waste and Inferior Fuels (85522 A). From address by J. Drummond Paton before Manchester Geol. & Min. Soc. Also discussion. 4000 w. Colly Gdn—March 22, 1918. Sources from which large supplies could be made available.

What Substitution of Oil for Coal Can Do (85477). Ills. 2500 w. Elec Wld—April 6, 1918. Actual experiences in New England resulting in increased economy.

Wood for Boiler Fuel (85839 A). C. T. Baker. 1500 w. Ind Man—May, 1918. In certain localities wood will produce a given amount of power at lower cost than coal.

Isolated Plants

Isolated Plant for Chemical Factory (85610). Ills. 1500 w. Pwr Pt Eng—April 15, 1918. Steel encased boilers, underfeed stokers and four-valve engines make for efficiency.

Piping

Piping for Steam-Generating Plants (85611). 2500 w. Pwr Pt Eng—April 15, 1918. Installation and operation from safety viewpoint.

Powdered Fuel

Powdered Fuel for Steam Raising (85879). 2000 w. Times Engng Supp—March 29, 1918. Drying and storing system, burners, furnace details, etc.

The Use of Coal in Pulverized Form (85807 D). H. R. Collins. 2500 w. A I M E. Bul—April, 1918. The preparation of the coal, the advantages of its use; essentials of feeder and burner; design of furnace, etc.

Steam Mains

Underground Steam Mains (85368). Charles L. Hubbard. Ills. 2200 w. Power—April 2, 1918. Serial. 1st part. Need of care in construction as they are less accessible.

Turbines

Low-Pressure Turbines for Lineshaft Drive (85662). R. J. Horne. Ills. 1500 w. Power—April 16, 1918. 600 hp. obtained in a paper mill without any cost for steam.

TRANSPORTING AND CONVEYING

Coal Handling

Coal Handling Plant at Oran, Algeria (85303 A). Ills. 2000 w. Engr—March 8, 1918. Modern, up-to-date coaling machinery.

Handling Coal and Ashes in the Boiler House (85623). Henry J. Edsall. Ills. 2500 w. Cl Age—April 13, 1918. A system believed to be a model installation.

Freight Handling

How Freight-Handling Machinery Is Being Used Abroad (85562). Harry Varndell. Ills. 1200 w. Eng News-Rec—April 11, 1918. For trans-shipment at ports, and for warehouse movements.

Handling Devices

British Shell-Shop Handling Devices (85838 A). George Frederick Zimmer. Ills. 3500 w. Ind Man—May, 1918. Serial. 2d part. Deals with jib and portable cranes, travelling jib cranes, telphers, transporters and shell-holding appliances.

Ore Loading

Installation Pour L'Embarquement (85890 B). Ills. 1000 w. Le Génie Civil—March 30, 1918. A loading conveyor for iron ore installed at Bilboa, Spain.

Shoveling Machine

Successful Shoveling Machine (85621). Ills. 1500 w. Cl Age—April 13, 1918. Its use for coal loading. Details of design and construction.

MISCELLANY

Warfare

Methods of Gas Warfare (85392 B). S. J. M. Auld. 5000 w. Jl Ind & Eng Chem—April, 1918. Methods of attack, etc.

ELECTRICAL ENGINEERING

COMMUNICATION

Phantom Circuit

Principle and Theory of Phantoms (85471). S. A. Kraus. 1800 w. Telephony—April 6, 1918. Conditions which may be relieved by phantom circuits. Read at Ohio convention.

Radiotelegraphy

Radio Inductive Interference (85335). Ellery W. Stone. Ills. 700 w. Telephony—March 30, 1918. Discussion of effect on telephone lines of inductive interference from radio stations.

Telephony

A Clearing House for Local Tolls (85766). B. E. Miller. 2000 w. Telephony—April 20, 1918. Read at convention of Wis. Telephone Assn. Discussion of local calls and the classification of long distance and local toll messages.

Loading Coils vs. Repeaters (85569 A). W. N. Furthman. Ills. 2500 w. Tel Engr—April, 1918. Properly designed and correctly installed, loading coils are adequate for all long distance work. Serial, 1st part.

Transmission Efficiencies of Cord Circuits (85568 A). Walter C. Freeman. Ills. 3000 w. Tel Engr—April, 1918. Ways and means of improving the electrical properties of circuits.

ELECTRO-CHEMISTRY

Carbon Cells

An Experimental Carbon Cell (85828 N). S. Albert Reed. Ills. 1200 w. Am El-Chem Soc—April-May, 1918. Describes apparatus.

Electrochemical Industries

Electrochemical Industries and the War (85903). G. A. Roush. 2500 w. Mfrs' Rec—April 25, 1918. Information concerning electrochemical products for war uses.

Central Stations and the Manufacture of Electrochemical Products (85361 A). C. A. Winder. 3000 w. Met & Chem Eng—April 1, 1918. Address at Dayton meeting of Ohio Elec. Lgt. Assn.

Electrometallurgy

The Design and Operation of a Small Kjellin Furnace (85360 A). George H. Stanley and W. Buchanan. Ills. 4000 w. Met & Chem Eng—April 1, 1918. Serial. 1st part. Manufacture of electric steel for stamp-mill shoes and dies on the Witwatersrand, South Africa. Combined abstract of two papers.

Electroplating

Brittleness Produced in Steel Springs by Electroplating (85830 N). O. P. Watts and C. L. Fleckenstein. 800 w. Am El Chem Soc—April-May, 1918. Tests on watch springs to determine cause of brittleness.

The Electrolytic Behavior of Manganese in Sulphate Solutions (85833 N). G. D. van Arsdale and C. G. Maier. 3000 w. Am El-Chem Soc—April-May, 1918. Study of current efficiencies, voltages and condition affecting the nature of deposits.

Ferro-Alloys

Methods for the Commercial Analysis of Ferro-Silicon (85829 N). Earl M. Anger. 2500 w. Am El-Chem Soc—April-May, 1918. Personal notes and experiences in the commercial analysis of electric-furnace ferro-alloys.

Muscle Shoals

The South's Greatest Offer to Electrochemistry—Muscle Shoals (85904). Ills. 1500 w. Mfrs' Rec—April 25, 1918. The benefits to be derived from the development of this water power. Amount now available.

Nitrate Plants

Over $150,000,000 to Be Expended in Muscle Shoals District for Four Nitrate Plants and Dams (85902). Thomas F. Logan. 3000 w. Mfrs' Rec—April 25, 1918. Development of an enormous water power in the Tennessee River and the erection of nitrate plants.

Nitrates

Nitrate Plants at Muscle Shoals Under Construction by the Government (85551). David Holt. Ills. 1500 w. Mfrs' Rec—April 11, 1918. Plant for making explosives nitrates.

Storage Batteries

The Calculation of Storage Battery Capacities (85835 N). C. W. Hazelett. 2200 w. Am El-Chem Soc—April-May, 1918. New conditions imposed by the use of storage batteries for starting, lighting and ignition of automobiles. Development of alignment chart and circular slide rule for calculating capacities.

Zinc Electrode

The Sign of the Zinc Electrode (85834 N). Wilder D. Bancroft. 2000 w. Am El-Chem Soc—April-May, 1918.

ELECTRO-PHYSICS

Dielectrics

The Characteristics of Dielectrics (85753). Chester Arthur Butman. 3000 w. Elec Wld—April 20, 1918. Interesting experimental facts.

Electromagnetic Theory

Some Applications of Electromagnetic Theory to Matter (85763 D). Albert C. Crehore. 33 pp. A I E E. Pro—April, 1918. A study of this theory and its applications.

GENERATING STATIONS

Central Stations

Operating Results in Central Stations (85389). 2000 w. Natl Engr—April, 1918. Shows how varying operating conditions affect the cost factors.

Chicago

New Generating Equipment at Chicago (85659). Ills. 1600 w. Elec Rev, Chi—April 13, 1918. Two new 35000-kilowatt turbogenerators installed by Commonwealth Edison Co.

Cincinnati

Cincinnati's New Source of Electric Energy Supply (85357). Ills. 2200 w. Pwr Pt Eng—April, 1918. Features of West End Power Station.

Combined Plant

Features of Steam Plant Supplementing Water Power (85754). Ills. 800 w. Elec Wld—April 20, 1918. Station at Hamilton, Canada, designed for 75000 kva. ultimate rating.

Coöperation

Cooperation of Public Service and Isolated Plants (85782). Ira N Evans 2500 w. Power—April 23, 1918. Cooperation will bring mutual profit, conserve coal and reduce investment for equipment.

Fuel

Economy in the Use of Fuel in Power Stations (85815 B). Charles H. Parker, with discussion. Ills. 26 pp. Bos Soc C E, Jl—April, 1918. Losses and methods of correcting them: mechanical stokers and their advantages; types; other instruments: suggestions, etc.

Hydro-Electric

Certain Hydro-Electric Power Possibilities in the Provinces of Quebec and Ontario, Canada (85831 N). Louis Simpson. 800 w. Am El-Chem Soc—April-May, 1918. Possible developments of the Ottawa and the St. Lawrence rivers.

Technisch-economische studie van waterkrachten (85857 B). G. H. Van M. Broekman. 4600 w. Ingenieur—March 9, 1918. Technical and economic study of water power. Economic aspects of development in all parts of the world.

Hydro-Electric Power Development in Australia and New Zealand (85369). Ludwig Schmidt. 3000 w. Power—April 2, 1918. Account of present development, proposed extensions and new enterprises.

Loads

Industrial Load Characteristics (85480). J. E. Mellett. Curves. 1200 w. Elec Wld—April 6, 1918. A study of typical daily load curves.

Power Service

Central or Independent Power Service (85503). Frederick B. Kenney, with discussion. 3000 w. Power—April 9, 1918. Read before Providence Eng Soc. Reasons for development of this central electric light and power industry.

Steam Turbine Plant

New Bedford Company's 52000-Kw. Station (85580). Ills. 2500 w. Elec Wld—April 13, 1918. Engineering features of steam-turbine plant.

Substations

Construction of Outdoor Substation at Madero, Cal. (85479). S. J. Moore Ills. 1200 w Elec Wld—April 6, 1918. Preference given to suspension insulators and wood poles: provisions for maintaining service.

Water Powers

Canada's Water Powers and Their Relation to the Fuel Situation (85487). J. B. Challies. Diagrams. 4000 w. Can Engr—April 4, 1918. Read before Can Soc. Civ. Engrs. Abundance of valuable water powers in various parts of the Dominion.

GENERATORS AND MOTORS

A. C. Generators

Operating Temperatures in Large A.-C. Generators (85339). H. D. Stephens. 1500 w. Elec Wld—March 30, 1918. Comparison of methods of measuring temperatures.

Vertical Shaft Water-Wheel Alternator (85780) H. D Stephens Ills 2500 w. Power—April 23, 1918. Construction, thrust-bearing, methods of lubrication and schemes employed to drive the exciter

Armature Reaction

Armature Reaction of Polyphase Alternators (85408 A) F. D. Newbury Ills 3000 w Elec Jl—April, 1918. Serial, 1st part Analysis of armature windings

D. C. Armatures

Elementary Principles of Continuous-Current Armature Winding (85784 A). F. M. Denton. Ills. 2000 w. Elec'n—March 29, 1918. Serial. 1st part. Classes of windings explained and terms defined.

D. C. Generators

Parallel Operation of Direct-Current Generators (85661). T. F. Barton. Ills. 1200 w. Power—April 16, 1918. Adjustments to obtain the proper characteristics.

Electric Motors

Electric Motors: Their Types, Characteristics, Applications and Control (85521 A). R. E. Neale. 2000 w. Mech Wld—March 22, 1918. Serial. 1st part. Review of principal types, their construction, etc.

Induction Motors

A Physical Conception of the Operation of the Single-Phase Induction Motor (85765 D). B. G. Lamme. Ills. 30 pp. A I E E, Pro—April, 1918. A study of the action, found convenient from the educational standpoint.

No-Load Conditions of Single-Phase Induction Motors and Phase Converters (85764 D). R. E. Hellmund. 85 pp. A I E E, Pro—April, 1918. Shows methods and derives formulas for the determination of the fields, the stator and rotor magnetizing currents, etc.

Reconnecting Induction Motors—For Changes in Number of Poles (85500). A. M. Dudley. Ills. 2500 w. Power—April 9, 1918. Effect on operation.

Motor Starting

Improving Synchronous-Motor Starting Features (85478). Theo. Schou. Ills. 2000 w. Elec Wld April 6, 1918. Possible improvements in design with brief record of results.

Rotor Design

The Mechanical Design and Specification of the Turbo-Alternator Rotor (85716 N). S. F. Barclay. Ills. 18 pp. Instn E E—March 26, 1918. Read before Manchester Local Section. Reviews conditions underlying the design and suggests a specification for the guidance of the purchaser.

Ventilation

Ventilation Systems for Steam Turbine Alternators (85565 A). E. Knowlton and E. H. Freiburghouse. Ills. 3000 w. Gen Elec Rev—April, 1918. Serial. 1st part. The present article considers the design of the ventilating system.

ILLUMINATION

Color Hygiene

Color in Illumination (85573 A). Beatrice Irwin. Ills. 2000 w. E Cb Phila, Jl—April, 1918. Coöperation between color-science and illuminating engineering in the interest of utility, beauty and hygiene.

Economy

Lighting Curtailment (85609 C). Preston S. Miller, with discussion. Ills. 58 pp. Ill Eng Soc, Trans—March 20, 1918. Accomplishes little as a coal-saving measure.

Fountains

An Electrically Illuminated Fountain (85356). A. L. Powell. Ills. 1500 w. Elec Rev, Chi—March 30, 1918. Construction and wiring features.

Light Projection

Light Projection with Gas-Filled Lamps (85579). R. P. Burrows and J. T. Caldwell. Ills. 3000 w. Elec Wld—April 13, 1918. Development has made possible their satisfactory use for motion-picture projection.

Motorcycles

Electric Lighting System for U. S. A. Motorcycles (85324). P. M. Heldt. Ills. 1500 w. Auto Ind—March 28, 1918. Tests prove possibility of controlling voltage without a battery in circuits.

MEASUREMENT

Rheostats

Compression Rheostats (85572 A). Arthur H. Allen. 2000 w. E Cb Phila, Jl—April, 1918. Special reference to rheostats known as the Allen-Bradley type.

POWER APPLICATIONS

Agriculture

Le Labourage Électrique (85889 B). Ills. 2400 w. La Nature—April 6, 1918. Electric tractors for plowing and harrowing taking current through a cable.

Electrical Equipment

Principles and Operation of Modern Electrical Equipment (85341). A. M. Pére. Ills. 1500 w. Pr House—March, 1918. Serial. 1st part. Practical applications of electricity in industrial engineering.

Electric Drive

Economy of Electric Drive in Cane Sugar Mills (85566 A). C. A. Kelsey. Ills. 7000 w. Gen Elec Rev—April, 1918. General and specific advantages, particular attention being given to the direct-connected motor-driven centrifugal pumps.

Solving Woodworking Drive Problems (85755). W. A. Black. Ills. 1500 w. Elec Wld—April 20, 1918. Method that practically eliminated repairs and reduced power bills.

Electric Kitchens

The Automobile Electric Kitchen (85567 A). Anson S. Rice. Ills. 2200 w. Gen. Elec Rev—April, 1918. Of special interest in connection with its use at army encampments.

Mine Power

The Economy of Electricity Over Steam for Power Purposes in and About the Mines (85794 D). 2500 w. A I M E, Bul—April, 1918. Discussion of R. E. Hobart's paper.

Hoists

Recent Developments of Electric Skip Hoists and Bell Hoists for Blast Furnaces (85715 N). David L. Linquist, with discussion. Ills. 52 pp. Assn I S E E—Feb., 1918. New developments in both alternating and direct current apparatus, with results of tests.

See also Rolling Mills, under Electrical Engineering, *Power Applications*.

TRANSFORMERS

Fuses

Assuring Satisfactory Fuse Operation (85578). Ills. 2000 w. Elec Wld—April 13, 1918. Proper installation and renewal of transformer fuses are essential to good service and the protection of apparatus.

TRANSMISSION AND DISTRIBUTION

Interconnection

Linking Up Rural Communities in Iowa (85489). Ills. & Map. 2000 w. Elec Rev, Chi—April 6, 1918. Transmission line economies and centralized generation supplies scattered settlements.

Line Sag

Sag-Temperature Calculations of Transmission Lines on Steep Grades (85724 B). Alfred Still. Ills. 1500 w. Fkn Inst, Jl—April, 1918. Recommended procedure.

M-Phase Systems

Harmonics in Symmetrical M-Phase Systems (85338). V. Karafeltoff. 2500 w. Elec Wld—March 30, 1918. Read before Am. Assn. for Adv. of Sci. Conditions which can exist in star-connected or mesh-connected systems having any number of phases.

Oil Switches

Tests on Oil Switches (85422 A). Bruno Bauer. 3500 w. Elec'n—March 15, 1918. Abstract of fourth report of the Commission on High-Tension Apparatus and Fire Protection. Deals with the thermodynamic and chemical processes inolved.

Pole-Line Costs

Studies in Wood, Steel and Concrete Pole-Line Costs (85490). F. L. Haushalter. 2500 w. Elec Rev, Chi—April 6, 1918. Serial. 1st part. Comparative costs. Advantages of preservative treatment for wood poles. Factors affecting cost.

Poles

Getting the Right Wood Poles for Electric Railway Service (85771). Charles R. Harte. Ills. 4500 w. Elec Ry Jl—April 20, 1918. Characteristics of available woods analyzed and specifications for pole purchase given.

Power Factor

Some Fundamental Considerations of Power Factor Correction (85713 N). R. A. McCarty, with discussion. 4500 w. Assn I S E E—Jan., 1918. Things that affect power factor and how corrected.

Switching

The Design of Automatic Switching Equipments (85409 A). R. J. Wensley. Ills. 4500 w. Elec Jl—April, 1918. Desirable features; a typical installation.

Safety Features in Switching Apparatus (85337). M. M. Samuels and F. N. Bechoff. Diagrams. 3000 w. Elec Wld—March 30, 1918. Ideas for designing or remodeling switching installations.

The Tendency Toward Outdoor Switching Apparatus (85411 A). H. G. MacDonald. Ills. 2200 w. Elec Jl—April, 1918. Shows economy effected, etc.

Three-Phase

Operating Features of Three-Phase Four-Wire Distribution (85776). George E. Wagner. 3300 w. Elec Rev, Chi—April 20, 1918. The economies, advantages and precautions accompanying distribution.

MISCELLANY

Electrical Industry

Substitutes in the German Electrical Industry (85414 A). 3300 w. Engng—March 8 1918. Information from address of M. T. Husberg before a meeting of Swedish Electricity Works.

CIVIL ENGINEERING

BRIDGES

Arch Design

The Design of a Three-Hinged Arch (85604 A). P. H. Chen. Ills. 12 pp. Corn C E—Feb., 1918. Investigation of the relative stiffness of steel arch ribs with three, two and no hinges.

See also same heading under Measurement.

Arches

The Economics of Steel Arch Bridges (85317 D). J. A. L. Waddell. Ills. 40 pp. A S C E, Pro—March, 1918. Aims to settle every important economic question that can arise in the designing of steel arches.

Concrete

Construction Features of Derby-Shelton Concrete Bridge (85296). Richard L. Saunders. Extracts from paper before Conn. Soc. of Civ. Engrs. Ills. 2000 w. Eng & Con—March 27, 1918. Details of work on bridge over the Housatonic River. Designed to meet conditions.

Hell Gate

The Hell Gate Arch Bridge and Approaches of the New York Connecting Railroad Over the East River in New York City (85319 D). Ills. 11 pp. A S C E, Pro—March, 1918. Continued discussion of O. H. Ammann's paper.

Kettle Rapids

Kettle Rapids Bridge (85810). W. Chase Thomson. Ills. 3500 w. Can Engr—April 18, 1918. Details of Canadian bridge over the Nelson River. Design and construction.

Piers

Method of Constructing and Sinking Floating Caisson for a Bridge Pier (85705). U. W. Mayo, in Qr. Bul. of Bur. of Pub. Wks., Manila. 2500 w. Eng & Con—April 17, 1918. Used in construction of Jones bridge over the Pasig River in the City of Manila, P. I.

Swingbridge

Drum and Track Failure Endangers Important Swingbridge (85741). Ills. 1200 w. Eng News-Rec—April 18, 1918. Deterioration of bridge in New Jersey after seven years' service.

Switzerland

Ergebnisse der Untersuchung von Eisenbeton-Brücken der Schweiz-Bundesbahnen (85860 B). A. Bühler. Ills. 2000 w. Schweiz-Bauzeitung—Feb. 23, 1918. Critical study of various designs of reinforced concrete bridges of the Swiss Federated Railways.

Viaducts

Effective Concrete Architecture in New Viaduct (85733). Ills. 2000 w. Eng News-Rec—April 19, 1918. Design and construction methods.

Hinged Polygonal Steel Arch Carries Viaduct Spans (85327). Ills. 1500 w. Eng News-Rec—March 28, 1918. Plate-girder spans supported by novel use of arch trusses over deep gorge near Marquette, Mich.

CONSTRUCTION

Chimneys

Brick Chimney of Record Height Built to Carry Off Smelter Gases (85464). Charles Evan Fowler. Ills. 1200 w. Eng News-Rec—April 4, 1918. Proportioned to resist wind pressure of 78 lb. per sq. ft. Foundations carried down to hard clay.

Construction Plant

Arch Bridge Is Concreted from Cars on Elevated Track (85739). Ills. 1000 w. Eng News-Rec—April 18, 1918. Unusual construction plant at Des Moines, Ia.

Factory Floors

Causes and Prevention of Failure in Creosoted Wood Block Factory Floors (85298). Lambert J. Ericson. Abstract of paper before Am. Wood Preservers' Assn. 2500 w. Eng & Con—March 27, 1918. Conclusions based on service records and personal observations.

Housing

Recent Dwelling Construction in Pennsylvania (85750). Dever C. Ashmead. Ills. 1500 w. Cl Age—April 20, 1918. Miners' houses, with bill of materials.

Unit-Built Concrete Cottages to House Foreign Labor (85558). Ills. 1500 w. Eng News-Rec—April 11, 1918. Dwellings in Youngstown Sheet & Tube Co.'s village.

Italy

La Diga Di Combamala Dell 'Impiant Del III Salto Della Maira (85868 B). Ills. 1000 w. L'Industria—Feb. 15, 1918. Large reinforced concrete dam 124 ft. high.

Partitions

Some Practical Points in the Design and Construction of Partitions (85809). H. L. Barraclough. Read before the Concrete Inst. 2000 w. Can Engr—April 18, 1918. Considers a few classes of fire-resisting partitions most used, their construction and troubles.

Piers

Handling Machinery Feature of Erection of Ocean Pier (85911). 2200 w. Eng News-Rec—April 25, 1918. Details of machinery used for heavy timber work at Vancouver terminal.

Reinforced Concrete

Results of Test on Robert Simpson Building (85363). W. W. Pearse and Peter Gillespie. Ills. 2300 w. Can Engr—March 28, 1918. Test of Toronto building constructed on the four-way reinforced concrete system.

Roofs

Light and Ventilation Insured in Factory by Unique Roof (85469). Nelson J. Bell. Ills. 1000 w. Eng News-Rec—April 4, 1918. Special form of concrete sawtooth.

Timber-Arch Truss Roof with Steel Gasset-Plates (85325). H. W. Sheley. Ills. 1800 w. Eng News-Rec—March 28, 1918. Details of three-hinged arch garage roof in Salt Lake City.

Simplon

Der Förderbetrieb beim Ausbau des II. Simplontunnels (85862 B). F. Rothpletz and C. Andreæ. Ills. 2800 w. Schweiz. Bau-Zeitung—March 2, 1918. Serial, 1st part. Construction of second Simplon tunnel. General features of the work.

Steel Arch

Steel Roof Trusses Are Designed as Elastic Arches (85736). W. Stuart Tait. Ills. 1800 w. Eng News-Rec—April 8, 1918. A steel arch of unusual design for the roof of a natatorium in Moline, Ill.

IRRIGATION AND RECLAMATION

California

Terra Bella Irrigation Project Obtains Supply from Wells and Delivers Water Under Pressure Through Steel Pipe Lines (85554). 3000 w. Eng & Con—April 10, 1918. Account of a $1,000,000 irrigation development depending entirely on underground water.

Leakage

Why Some Irrigation Canals and Reservoirs Leak (85468). A. P. Davis. Ills. 2500 w. Eng News-Rec—April 4, 1918. Subterranean cavities cause settlements when water is turned in.

Pumping

Irrigazione Con Sollevamento Meccanico (85869 B). C. Fadini. Ills. 1400 w. L'Industria—Feb. 28, 1918. Irrigation in Italy with electrically driven centrifugal pump system.

Reservoirs

Tumalo Irrigation Storage Reservoir Leaked Profusely and Erratically (85,-732). J. P. Newell. Ills. 2500 w. Eng News-Rec—April 18, 1918. Lessons from the history of the Tumalo irrigation project in the state of Oregon.

MATERIALS OF CONSTRUCTION

Cement

Some Generalizations on the Influence of Substances on Cement and Concrete (85532 N). J. C. Witt. 20 pp. Phil Jl Sci—Jan., 1918. A study of investigations, giving tabulated results.

Concrete

Concrete in Western Canada (85811). J. F. Greene. Read before Manitoba Br. of Can. Soc. Civ. Engrs. 3500 w. Can Engr—April 18, 1918. The deterioration of concrete under the action of alkali waters.

Corrosion

Roesten van het iizer in gewapend beton (85856 B). J. A. Bakker. Ills 4200 w. Ingenieur—Mar. 2, 1918. Corrosion of iron in reinforced concrete. Illustrations from existing structures and recommended practise for prevention.

Fuel

Is Our Fuel Supply Nearing Exhaustion? (85571 A). R. H. Fernald. Ills. 7500 w. E Cb Phila. Jl—April, 1918. Amount of reserves; demands; need of conservation, etc.

Lead Wool

Lead Wool (85675 N). R. J. Thomas. 2000 w. Am Wr Wks Assn, Jl—March, 1918. Material for calking joints in cast iron pipes, and other uses.

Pipe

Reinforced Concrete Pipe (85762 B). George C. Bartram. Ills. 20 pp. Mun Engrs Jl—April, 1918. Reviews the development; method of manufacture; tests, etc.

Refractories

Fireclays and Ganisters of the South of Scotland (85783 A). L. W. Hinxman. Read before Ceramic Soc., Glasgow. 4500 w. Quarry—April, 1918. Deposits used in the manufacture of high-class refractory goods.

Slabs

Some Notes on Flat Slab Design: Bending Moments, Exterior Panels, Spandrels, Arrangement of Reinforcement (85295). Albert M. Wolf. Diagrams. 3500 w. Eng & Con—March 27, 1918. Critical discussion of the Chicago Rulings and the Concrete Institute recommendations.

Timber

The Artificial Seasoning of Wood (85756). Percy Groom, with discussion. Read before Inst. of Auto. Engrs. 6000 w. A A Wkly—April 22, 1918. Construction of wood-drying, shrinkage, warping, seasoning, etc.

Timber Preservation

The Preservation of Wood in Connection with the Building of Wharves and Docks (85597 A). Hermann von Schrenk. Ills. 2500 w. Int Mar Engr—April, 1918. Advantages of the creosoting process.

MEASUREMENT

Arches

Calcul Des Vontes En Beton Armé (85859 B). L. R. De La Mahotière. Ills. 3200 w. Le Génie Civil—Mar. 23, 1918. Calculation of the strength of reinforced concrete arches.

Earth Dams

Tests to Determine Pressures Due to Hydraulic Fills (85735). A. W. Goldbeck. Ills. 2000 w. Eng News-Rec—April 18, 1918. Method of measuring stability of dikes against thrust of clay core.

Floors

Computing Moments on Irregularly Spaced Flat-Slab Panels (85465). W. Stuart Tait. 1500 w. Eng News-Rec—April 4, 1918. Analyzed by using three-moment theorem.

Hardness

Two Field Methods for the Determination of the Total Hardness of Water (85531 N). A. S. Behrman. 2000 w. Phil Jl Sci—Jan., 1918. Details of methods and results.

Hell Gate Bridge

Stress Measurements on the Hell Gate Arch Bridge (85323 D). Ills. 8 pp. A S C E, Pro—March, 1918. Continued discussion of D. B. Steinman's paper.

Meridiograph

The Ross Meridiograph (85751). J. T. Beard. Ills. 1700 w. Cl Age—April 20, 1918. The instrument and its use.

Surface Waters

Ice Diversion, Hydraulic Models, and Hydraulic Similarity (85328 D). 11 pp. A S C E, Pro—March, 1918. Continued discussion of Benjamin F. Groat's paper.

Surveying

Russian Engineers Make Intensive Hydrometric Survey in Crimean Upland (85466). D Kotcherin Ills 700 w. Eng News Rec—April 4, 1918 Outline of work.

Water Analysis

Water Analysis in the Field (85530 N). George W. Heise and A. S. Behrman. Plate. 17 pp. Phil Jl Sci—Jan., 1918. Outlines and discusses methods.

Water Tests

A Small Water Works Testing Laboratory (85674 D). A. N. French, with discussion. 2000 w. N E W-Wks Assn—March, 1918. Details of apparatus and arrangement.

Weirs

Verification of the Bazin Weir Formula by Hydro Chemical Gaugings (85322 D). 2000 w. A S C E, Pro—March, 1918. Discussion of Floyd A. Nagler's paper.

Mitteilung uber Versuche zur Verhütung von Kolken an Wehren (85863 B). H. E. Gruner and E. Locher. Ills. 2600 w. Schweiz. Bauzeitung—Jan. 19, 1918. Serial, 1st part. A study of pools of "dead water" in flumes and conduits.

MUNICIPAL

Designs

Economic Considerations in Municipal Engineering Designs (85556). Clinton S. Burns. 2500 w. Eng & Con—April 10, 1918. Estimates based on normal prices, and points in planning an economic system.

Sewage Disposal

Considerations Leading to Recommendations for Fine Screens, Sprinkling Filters, Humus Tanks, and Sludge Recovery as Sewage Disposal Method for Indianapolis (85557). From paper by George W. Fuller to Indiana Sanitary and Water Supply Assn. 4000 w. Eng & Con—April 10, 1918.

Sewage Treatment

Specific Suggestions on the Designs of Imhoff Sewage Settling Tanks (85508 A). Charles F. Mebus. Ills. 2000 w. Mun Eng—April, 1918. Importance of studying each installation. Details discussed.

Suggestions on the Design and Operation of Sewage Treatment Plants (85553). From J. H. Dunlap's paper before Iowa Eng. Soc. 2500 w. Eng & Con—April 10, 1918. Suggestions to meet Iowa conditions.

The New Sewage Treatment Plant at Xenia, Ohio (85509 A). W. J. Sherman. Ills. 700 w. Mun Eng—April, 1918. First plant a failure; design of new plant.

Small Town Sewage-Works Operation Problems Analyzed (85740). J. H. Dunlap. 2500 w. Eng News-Rec—April 18, 1918. Results of inspecting plants in 39 cities in Iowa.

Sewerage

Distinctive Characteristics of Institutional Sewerage (85915). Henry W. Tay-1918. 2200 w. Eng News-Rec—April 25, 1918. Data on quantity and quality and the effect on design of sewers and treatment of sewage.

Sewer Pipes

Sealing Sewer Pipes with S P C Pipe Seal Compound (85603 A). S. N. Williams. 900 w. Com C E—Feb., 1918. Use of pipe seal compound for sealing joints of pipe in wet trenches.

Sewers

Estimating Contractors' Overhead Costs in Sanitary Sewer Construction (85555). Stanley D. Moore. Address to Iowa Eng Soc. 2000 w. Eng & Con—April 10, 1918. Analysis of overhead charges, etc.

Present Tendencies in Sewer Construction and Design (85507 A). H. K. Barrows. Ills. 1500 w. Mun Eng—April, 1918. Effect of war conditions; labor-saving machinery; construction, etc.

ROADS AND PAVEMENTS

Accounting

Uniform Methods of Road Construction Accounting Desirable (85563). Edward N. Hines. 2500 w. Eng News-Rec—April 11, 1918. Variety of systems used.

Asphaltic-Concrete

Method of Constructing Asphaltic Concrete on Dundas St., York County, Ontario (85462). From paper by R. Crawford Muir, before conference of Ontario Road Supts. Ills. 2200 w. Eng & Con—April 3, 1918.

Brick

Iowa County Builds Brick Road From Camp Dodge to Des Moines (85738). Ills. 1800 w. Eng News-Rec—April 18, 1918. Rapid paving for military traffic.

Concrete

Construction Plant and Methods Employed in Building Concrete Roads in Wayne County, Mich. (85505 A). Ills. 2000 w. Mun Eng—April, 1918. Methods employed give best results at least cost.

Concrete Roadways for Shops of the A., T. & S. F. Ry., at Topeka, Kan. (85767). Con M. Buck. Ills. 1800 w. Ry Rev—April 20, 1918. Roads for electric tractor and trailer haulage; data of hauling tests on roads of different materials.

Suitable Concrete Roads Could Carry One Million Tons of Freight Each Way Daily (85749 A). Ills. 1500 w. Com Vhle—April 15, 1918. Their construction. Saving possible through small resistance.

Contracts

More Equitable Contracts Between Highway Commissions and Contractors (85463). Abstract of paper by James C. Travilla, before the Am. Road Bldrs. Assn. 2500 w. Eng & Con—April 3, 1918. Suggested methods.

Highways

Great Development of Highway Transportation Demands Wider and Stronger Roads (85456 A). George C. Diehl. Ills. 1500 w. Com Vhle—April 1, 1918. Roads should not be less than 20 ft. in width.

Highway Problems Considered Under Ten Main Heads (85328). Extracts from a lecture by H. Eltinge Breed before the Roads School of Mich. Univ. 4500 w. Eng News-Rec—March 28, 1918. Bond limitations, better drainage, lower grades.

Maintenance

Cost Curve of Highway Maintenance Has Well-Defined Minimum (85734). H. G. Shirley. 2000 w. Eng News-Rec—April 18, 1918. Studies indicate that expenditure depends on amount of traffic and type of tire.

Pavements

Considerations Affecting the Design of Pavement Foundations (85504 A). H. J. Fixmer. 1500 w. Mun Eng—April, 1918. Points to be considered in designing various types.

Secondary Roads

Methods and Cost of Constructing and Maintaining Secondary Roads in Southern California (85461). E. Earl Glass. Ills. 1800 w. Eng & Con—April 3, 1918. Methods for oiled earth roads.

WATER SUPPLY

Dams

Construction of the Phelps Brook Dam. —Water Supply for Hartford, Conn. (85671 D). J. F. Shaughnessy, with discussion. 2500 w. N E W-Wks Assn—March, 1918. Details of the work.

Method of Repairing Revetment on Belle Fourche Dam (85703). B. E. Hayden 2000 w. Eng & Con—April 17, 1918. Details of work in South Dakota.

New Installation Keeps Ice Away from Keokuk Dam (85914). Ills. 2000 w. Eng News-Rec—April 25, 1918. Pipe line across river supplies constant current of air and prevents ice forming.

Middle Section of Upstream Side of Calaveras Dam Slips Into Reservoir (85470). Allen Hazen and Leonard Metcalf. Ills. 2200 w. Eng News-Rec—April 4, 1918. Estimated that the slide involves 800,000 to 2,800,000 yards placed.

Filtration

Some Methods and Results of Filtration at Providence Water Works (85670 D). Frank L. Cady. Ills. 17 pp. N E W-Wks Assn—March, 1918. Construction and statistics.

Leakage

Leakage from Vitrified Pipe Used to Convey Water Under a Low Head (85676 N). William W. Brush. Ills. 3500 w. Am Wr Wks Assn, Jl—March, 1918. Describes N. Y. city pipe line, the leaks repaired, tests of joint material and conclusions.

Mains

Matheson Joint Steel Water Mains (85673 D). F. N. Speller. Ills. 900 w. N E W-Wks Assn—March, 1918. Reliability, durability etc.

Mains (85672 D). 11 pp. N E W-Wks Assn—March, 1918. Topical discussion.

Organisms

Control of Microscopic Organisms in Water Supplies (85669 D). William Haine, with discussion. 11 pp. N E W-Wks Assn—March, 1918. Non-technical discussion of the relation of "microscopic organisms" to water supply troubles.

Pipe Thawing

Practice in Thawing Water Service Pipes, Mains and Hydrants in North Attleboro, Mass. (85510 A). William Plattner Ills. 1500 w. Mun Eng—April, 1918. Details of electric thawing equipment used with satisfactory results.

Pollution

The Differentiation of Bacteria of the Colon-Aerogenes Family (85677 N). William Mansfield Clark. 3500 w. Am Wr Wks Assn, Jl—March, 1918. A study of this group in its relation to water supplies.

Potable Water

Acting on Recommendations of U. S. Public Health Service in Improving Quality of Meridian, Miss., Water Supply (85506 A). M. L. Worrell. 1500 w. Mun Eng—April, 1918. Describes conditions and gives recommendations.

Potable Water in India (85880). 2000 w. Times Engng Sup—Mar. 29, 1918. Difficulties in securing good sources; waste, spread of disease, etc.

Purification

Water Supply Standards and Their Improvement (85678 N). William J. Orchard, with discussion. 14 pp. Am Wr Wks Assn, Jl—March, 1918. Standards for the protection of water supplies. Inspection, etc.

Rates

Pennsylvania Water Rate Decision Covers Many Points (85329). Farley Gannett. 2500 w. Eng News-Rec—March 28, 1918. Supreme Court of Penn. has upheld the Public Service Commission and reversed the Supreme Court in the Ohio Valley Water Co. rate case. Points at issue.

Rate Revision in Municipal Works (85668 D). Bertram Brewer. 2500 w. N E W-Wks Assn—March, 1918. Outlines a method of treating the problem.

Reservoirs

Great Concrete Reservoir Built with Portable Mixers (85560). E. J. Lieber. Ills. 1500 w. Eng News-Rec—April 11, 1918. Big reservoir at Highland Park, Mich.

16,000,000-Gallon Elevated Reservoir at Buenos Aires (85529 A). Ills. 1200 w. Engr—March 15, 1918. Details of two reservoirs recently put into service.

Sterilization

Chlorination and Chloramine (85679 N). Joseph Race. 20 pp. Am Wr Wks Assn, Jl—March, 1918. Continuation of an earlier study, attempting to place water chlorination on a scientific basis.

Water Works

Complete Reconstruction of Water Works Plant Including Filtration System on Site of Old Plant, Without Interruption of Service (85552). Ills. 2000 w. Eng & Con—April 10, 1918. Work at Fort Madison, Ia.

Fort Madison Water-Works Rehabilitated by Citizens' Corporation (85737). R. E. McDonnell. Ills. 1500 w. Eng News-Rec—April 18, 1918. Extensive repairs without interrupting service.

Winnipeg District

The Greater Winnipeg Water District (85488). C. S. C. Landon. Ills. 4000 w. Can Engr—April 4, 1918. Serial, 1st part. Recommendations of a board of consulting engineers, and details of the scheme.

WATERWAYS AND HARBORS

Canals

Compressed Air Tunnel Driven Around Lock to Check Leak in Wall (85559). S. S. Hammel. Ills. 1800 w. Eng News-Rec—April 11, 1918. Completed without interference of water level in canal. At Seneca Falls, N. Y.

The New Orleans Industrial Canal (85813 A). A. M. Lockett, with discussion. 30 pp. La Eng Soc, Pro—April, 1918. Reasons for this canal; history of the project; and expected advantages.

Dredge

Large Sand Digger Has Main Screen on Deck (85326). Ills. 1500 w. Eng News-Rec—March 28, 1918. Details of Ohio River dredge and its output.

Hydraulic Phenomena

Hydraulic Phenomena and the Effect of Spreading of Flood Water in the San Bernardino Basin, Southern California (85318 D). 13 pp. A S C E, Pro—March, 1918. Continued discussion of A. L. Sonderegger's paper.

Panama Canal

Tests of the Chain Fenders in the Locks of the Panama Canal (85700 N). Henry Goldmark. Ills. 19 pp. Can Soc C E—March 28, 1918. Tests made during the construction of the fenders, and since the canal has been in use.

Ports

Ports and Terminal Facilities (85570 A). R. S. MacElwee. Ills. Also discussion by George S. Webster. 10500 w. E Cb Phila, Jl—April, 1918. Their importance, efficiency, requirements, etc.

St. Thomas

The Port of St. Thomas (85874). 1200 w. Naut Gaz—Mar. 28, 1918. Manifest advantages and future prospects under U. S. control of this West India island.

MISCELLANY

Engineering Council

An Engineering Council Now Almost Forgotten (85912). F. H. Newell. 2800 w. Eng News-Rec—April 25, 1918. Organized in 1886 to promote an improved system of public works.

Engineers's Work

Railway Regiment Handles Jobs of All Kinds in France (85561). Robert K. Tomlin, Jr. Ills. 2500 w. Eng News-Rec—April 11, 1918. Some of the work undertaken by American engineers.

MARINE AND NAVAL ENGINEERING

Battleships

The Italian Battle Fleet (85700 A). Ills. 2500 w. Engr—March 22, 1918. Explains the difficulties to be met in the Adriatic, and the inadequacy of the Italian Navy to meet conditions. Describes types of battleships.

Cargo Ships

Cargo Steamers (85885). 2600 w. Times Engng Supp—Mar. 29, 1918. Discussion of standard designs before Inst'n Naval Architects.

Reinforced-Concrete Sea-Going Cargo Steamers (85690 A). T. G. Owens Thurston. Read before Instn. of Nav. Archts. Ills. & Plates. 4500 w. Engng—March 29, 1918. Design and construction of self-propelled vessels now building in Great Britain.

Standard Cargo Ships (85523 A). George Carter. Read before Instn. Nav. Archts. Ills. 4500 w. Engng—March 22, 1918. The advantages as a war measure, and some account of the design and construction.

The Most Suitable Sizes and Speeds for General Cargo Steamers (85524 A). John Anderson. Ills. 3300 w. Engng—March 22, 1918. Read before Instn. Nav. Archts. Method of arriving at the most economical dimensions for any length of voyage, condition of loading, or speed.

Classification

American Classification for American Ships (85591 A). Winthrop L. Marvin. 3500 w. Int Mar Eng—April, 1918. Suggestions from the committee on merchant marine of the Boston Chamber of Commerce, with review of history of American navigation.

Concrete Ships

Concrete Ships (85886). 2700 w. Times Engng Supp—Mar. 29, 1918. Design and particulars of vessels under construction in British yards. Methods found best adapted to conditions there.

Ferro-Concrete Ships (85537 A). T. J. Gueritte. Read at N-E Coast Instn. of Engrs. & Shipbldrs. 7500 w. Engng—March 15, 1918. Materials of construction, systems, speed, repairs, lasting qualities, weight and cost.

The Development of Concrete Barge and Ship Construction (85384 A). J. E. Freeman. Ills. 6000 w. A S M E, Jl—April, 1918. Abstract of paper before Eng. Soc. of Buffalo. Brief review of progress in concrete-boat building, and discussing problems.

The Possibilities of the Ferro-Concrete Ship (85701 A). Maurice Denny. Ills. 7500 w. Engng—April 5, 1918. Read before the Instn. of Nav. Archts. A preliminary survey of the possibilities of this material for ships.

Will the Concrete Steamship Measure Up to Builders' Expectations? (85421). Albert Phenis. Ills. 1500 w. Mfrs' Rec—April 4, 1918. Discusses the advantages and disadvantages of concrete ships, and their reliability.

Decking

Magnesite Composition Decking (85,593 A). G. W. Selby. 2000 w. Int Mar Eng—April, 1918. How it is manufactured and applied.

Diesel Engines

See same heading under Mechanical Engineering, *Combustion Motors.*

Emergency Fleet

The Organization of the Emergency Fleet Corporation (85581 A). Waldon Fawcett. 5000 w. Int Mar Eng—April, 1918. Explains the problems and the administrative machinery of the greatest shipbuilding enterprise ever undertaken.

Greenheart

Greenheart for Ships (85876). Ills. 1500 w. Naut Gaz—April 4, 1918. Recent recognition of advantages of this wood from British Guiana for shipbuilding.

Japanese Navy

Japanese Naval Expansion (85304 A). 1500 w. Engr—March 8, 1918. Development of the Japanese navy, and the new building programme.

Mahogany

Mahogany as a Shipbuilding Wood (85877). C. D. Mell. Ills. 1400 w. Naut Gaz—April 18, 1918. Advantages of mahogany for ship construction and present sources of supply.

Marine Engineers

The Marine Engineer and His Work (85663). 4000 w. Power—April 16, 1918. Informal talk before M. I. T. graduating class on the duties and responsibilities of engineers on board a North Atlantic greyhound.

Merchant Marine

The Merchant Ship of the Future (85603 A). W. S. Abell. 5000 w. Engng—March 29, 1918. Read before Instn. of Nav. Archts. Future problems in design and construction

Motorships

Motorships and Their Propelling Machinery (85590 A). J. Murray Watts. Ills. 3000 w. Int Mar Eng—April, 1918. Designs of six classes vessels being equipped with internal combustion engines.

Navigation

The Chart as a Means of Finding Geographical Position by Observations of Celestial Bodies in Aerial and Marine Navigation (85315 A). G. W. Littlehales. Maps and Tables. 2000 w. U S Nav Inst Pro—March, 1918.

Research

Research in Marine Engineering (85,694 A). A. E. Seaton. Read before Instn. of Nav. Archts. 4500 w. Engng—March 29, 1918. Notes on the importance of research work.

Shipbuilding

America to Lead World in Shipbuilding (85301 A). 3000 w. Iron Age—March 28, 1918. Address of Edward N. Hurley to National Marine League.

Reinforced Concrete Vessels (85750 A). Walter Pollock. Ills. 4000 w. Engr—March 29, 1918. Abstract of paper read before the Inst. of Naval Archts. The points aimed at, advantages and disadvantages, materials, structural details, etc.

Seattle Speeds Up Shipbuilding (85,502 A). Ills. 1800 w. Int Mar Eng—April, 1918. Swift construction of shipyards and ships.

Shipbuilding and Labor Problems (85,393 A). Charles Piez. 2500 w. Iron Age—April 4, 1918. From address to Natl. Metal Trds. Assn. Emphasizes statement that workers must be released for ship work.

Some Minor Details of Ship Construction and Equipment (85390). C. Waldie Cairns. 3000 w. Mar Eng, Can—March, 1918. Serial, 1st part. Advisability of adopting a "Standard Fittings Specification." Read before N-E Coast Instn.

South Launches New Type of Ship (85308 A). H. H Dunn. Ills 1000 w. Mar Rev—April, 1918. Wooden ship recently launched at Orange, Texas, embodying original features.

Where to Recruit Shipyard Labor (85307 A) 17 tables. 2500 w. Mar Rev—April, 1918. Analysis of the shipyard trades showing how kindred trades can supply skilled men

Will There Be Enough Ship Steel? (85306 A). E. C. Kreutzberg. Ills. 1700 w. Mar Rev—April, 1918. A study of the fabricated ship problem from the steel manufacturer's standpoint.

Straight Lined and Fabricated Ships (85598 A). John A. McAleer. Ills. 2200 w. Int Mar Eng—April, 1918. The application of the principle to shipbuilding.

Shipyards

A Big Transportation Problem at Hog Island (85743). Ills. and Map. 3500 w. Ry Age—April 19, 1918. Shows the rapid construction of this large shipyard dependent on ability to deliver men and materials.

Construction of Newark Bay Shipyard (85583 A). Ills. 1800 w. Int Mar Eng—April, 1918. Arrangements for building 5,000-ton fabricated ships.

Hog Island Yard Starts Building Ships (85582 A). Ills. 2200 w. Int Mar Eng—April, 1918. Work at this great government plant—30,000 men employed.

Rapid Progress Now Being Made at Hog Island (85824 A). Ills. 2000 w. Iron Age—April 25, 1918. Large shipyard on Delaware River nearing completion.

Shipping Board's Bristol Plant (85,584 A). Ills. 2200 w. Int Mar Eng—April, 1918. Shipyard and industrial town.

Shipyard of the Sun Shipbuilding Company (85586 A). Ills. 2000 w. Int Mar Eng—April, 1918. Splendidly arranged and equipped plant at Chester, Pa., for building standard types of oil tankers and steel cargo vessels.

The Hog Island Ship Yard (85354). Ills. 3000 w. Ry Rev—March 30, 1918. History of the development, etc.

The Shooters Island Shipyard (85,587 A). Ills. 1500 w. Int Mar Eng—April, 1918. Reconstructed plant of the Standard Shipbuilding Corporation.

Steaming Data

Convenient Method of Handling Steaming Data (85316 A). Jules James. 2000 w. U S Nav Inst, Pro—March, 1918. Set of curves, explaining their use.

Steamships

Five Thousand-Ton Deadweight Fabricated Steel Cargo Steamer for Emergency Fleet (85588 A). Ills. 5000 w. Int Mar Eng—April, 1918. Details of vessel being built at Newark Bay plant.

Submarines

Campagne des Sous-Marins Contre Le Marine De Commerce (85888 B). E. Bertin. Ills. 6300 w. La Nature—Mar. 30, 1918. Submarine warfare and means of protecting merchant ships.

Terminals

Marine Terminal Engineering (85,506 A). H. M. Harding. 3500 w. Int Mar Eng—April, 1918. Lecture at Sheffield Scientific School. Terminal facilities: arrangements; fireproofing, etc.

Concrete in Marine Terminals (85,595 A). H. Colin Campbell. Ills. 3000 w. Int Mar Eng—April, 1918. Various uses to which it is applied.

Turning Radius

La Legge Di Similitudine — Delle Qualita Evolutive Delle Navi (85850 C + D). N. Pecoraro. Ills. 4400 w. Rivista Marittima—Nov., 1917. A study of the facility for turning. Results obtained with an experimental ship.

United States

Greatest Maritime Nation of World Is Position United States Will Take (85313). Edward N. Hurley. Extracts from speech before Natl. Marine League, at Delmonico's, in New York. 2500 w. Mfrs Rec—March 28, 1918. Analysis of the shipbuilding situation.

Unsinkable Ship

Unsinkable Cargo Vessel (85875). 2600 w. Naut Gaz—Apr. 4, 1918. Isherwood system of design to secure greatest floatability after being torpedoed.

Valves

Safety and Relief Valves (85585 A). M. W. Link. Ills. 2000 w. Int Mar Eng—April, 1918. Serial, 1st part Construction and operation of valves for marine work.

Wooden Vessels

Largest Wooden Vessel Launched (85504 A). Ills. 1200 w. Int Mar Eng—April, 1918. Details of the "War Mystery" under construction in Texas.

MINING AND METALLURGY

BASE METALLURGY

Copper

Bibliography on the Physical Properties of Copper (85682 A). Paul D. Merica. 5 pp. Met & Chem Eng—April 15, 1918. Sources of information classified by topics.

Sacramento Hill Disseminated Copper Deposits (85770). Courtenay De Kalb. Ills. 2000 w. Min & Sci Pr—April 20, 1918. Serial, 1st part. Early history of the Bisbee copper mines; methods and cost of development.

Tin

Apuntes Acerca De Criaderos Estaniferos En Mexico (85866 D). 7100 w. Boletin Minero—Dec., 1917. Notes on tin deposits in various parts of Mexico. Digest of reports of the Mexican Geological Institute.

Zinc

Roasting Zinc Ore for Leaching (85616). Floyd Dixie James. 1800 w. Min & Sci Pr—April 13, 1918. Abstract from Bul. Missouri Sch. of Mines & Met. Oxidizing and sulphatizing roast; formation of zinc ferrite; leaching the calcine.

COAL AND COKE

Bituminous

Montour No. 8 Plant of the Pittsburgh Coal Co. (85336). George W. Harris. Maps & Ills. 2500 w. Cl Age—March 30, 1918 Description of plant with details of the No. 8 tipple.

Breakers

Successful Steel Breakers of the Lehigh Valley Coal Company (85620). George W. Harris. Ills. 4500 w. Cl Age—April 13, 1918. Details of steel breakers which are supplanting the wooden structures.

Coal Run Plant

New Plant and Mines of the Coal Run Mining Company (85492). Dever C. Ashmead. Ills. 2500 w. Cl Age—April 6, 1918. Details of new plant.

Coal Supply

The Problem of Coal Supply (85721 B). Edward W. Parker. Ills. 16 pp. Fkn Inst, Jl—April, 1918. Reviews theories of the formation of coal, extent of deposits in the United States, uses, and various phases of the problem.

Coal: The Resource and Its Full Utilization (85405). Abstract of paper by Chester G. Gilman and Joseph E. Pogue. 5000 w. Ry Rev—April 6, 1918. Wastes and possible economies in the use.

Coke Ovens

Chemists in Coke Oven Practice (85697 A). J. T. Dunn, with discussion. (Abstract.) 4500 w. Colly Gdn—March 28, 1918. The necessity for the employment of skilled chemists.

The Texture of Coke Oven Bricks (85696 A). W. G. Fearnsides, with discussion. (Abstract.) 3500 w. Colly Gdn—March 28, 1918. Results of research. Description of tests.

Collieries

Notes on Colliery Turbo Plant (85413 A). L. Fokes. Ills. 4500 w. Colly Gdn—March 15, 1918. General principles of operation.

Useful Instruments for Colliery Power Plants (85412 A). H. W. Ravenshaw. with discussion. Read before Midland Inst. of Min, Civ, & Mech Engrs. Ills. 8500 w. Colly Gdn—March 15, 1918. Calls attention to various means of maintaining efficiency and safety.

Fuel

Fuel Conservatism (85385 A). 7000 w. A S M E. Jl—April, 1918. Abstracts of papers by L. P. Breckenridge, and by O. P. Hood, and of discussions.

Fuel Storage

Preparing for Future Demands (85612). Ills. 1500 w. Pwr Pt Eng—April 15, 1918 A mammoth submerged coal shortage pit.

Inert Matter

Inert Matter in Coal (85881). 2000 w. Times Engng Supp—Mar. 29, 1918. Ash and waste matter. A hindrance to gas-making. Stack fires.

Mechanical Mining

Mechanical Mining Without Explosives (85622). N. D. Levin. Ills. 1800 w. Cl Age—April 13, 1918. Account of a machine that cuts, breaks down and loads coal

Powdered Coal

Powdered Coal for Power Plants (85401). Frederick Seymour. Ills. 2500 w. Elec Rev, Chi—April 6, 1918. Methods of overcoming difficulties.

See also Powdered Fuel, under MECHANICAL ENGINEERING, *Steam Engineering*.

Slack

Burning Slack Containing Excessive Moisture (85371). J. F. McCall. Ills. 900 w. Power—April 2, 1918. Successful experiments.

Small Coal

A System of Storing and Filling Small Coal, with Remarks Upon the Prevention of Spontaneous Heating in Coal-Heaps (85720 N). John Morison, with discussion. Ills. 11 pp. Instn Min Engrs, Trans—March, 1918. Gives results of experience.

Spontaneous Ignition

Spontaneous Heating of Slack Heaps (85785 A). George Knox. From Jl. of Monmouthshire Colliery Off. Assn. 2200 w. Colly Gdn—April 5, 1918 Cause of heating, treatment and prevention.

Spontaneous Ignition of Bituminous Coal (85660). J. F. Springer Ills. 3000 w. Power—April 16, 1918. Explains how it occurs, and gives results of experiments made to determine conditions favorable and unfavorable, and methods of storing coal to prevent such action.

Thawing Coal

A Modern Plant for Thawing Coal in Cars (85334). Scott W. Linn. Ills. 1200 w. Ry Age—March 29, 1918. A building of precast unit concrete construction.

Thin Beds

Working Thin Beds by Longwall (85493). Rowland Gascoyne. 3000 w. Cl Age—April 6, 1918. Most economical system to follow in beds less than 2 ft. 6 in. in thickness.

GEOLOGY

Somme Topography

Geographic Suggestions of the Somme Battlefield (85769). Bailey Willis. Maps. 3000 w. Min & Sci Pr—April 20, 1918. Topography of northern France and the Somme battlefield; geological basis.

Sudbury Ores

Genesis of the Sudbury Nickel-Copper Ores, as Indicated by Recent Exploration (85797 D). 4500 w. A I M E, Bul—April, 1918. Discussion of paper of Hugh M. Roberts and R. S. Longyear.

IRON AND STEEL

Blast Furnaces

Unique Feat in Blast Furnace Building (85708 A). Ills. 2500 w. Iron Age—April 18, 1918. Within one year 600-ton stack is completed; details of stoves and valves.

Blooming Mills

The Design of Blooming Mills (85300 A). H. H. Hummel. 4000 w. Iron Age—March 28, 1918. Faults of existing plants and the needed improvements.

Continuous Mills

Practical Operation of Motor-Driven Continuous Mills (85714 N). H. C. Cronk. 2500 w. Assn I S E E—Jan., 1918. Operating features of mills of the Morgan Construction Co. type.

Grain-Size

Grain-Size Inheritance in Iron and Carbon Steel (85790 D). 3000 w. A I M E, Bul—April, 1918. Discussion of the paper of Zay Jeffries.

Iron Industry

Economic Factors in the Iron Industry (85547 A). Malcolm Keir. 2500 w. Iron Age—April 11, 1918. Serial, 1st part. Brief history of development in the United States.

Ore Supplies

British Iron Ore Supplies (85820 B). 3000 w. Cas Eng Mthly—April, 1918. Urging the development of home resources.

Production

Decreased Production of Steel Corporation (85302 A). 3500 w. Iron Age—March 28, 1918. Interesting features of the year 1917, taken from annual report.

Rolling Mills

Electrical Reversing Rolling Mill (85536 A). Ills. & Plate. 2000 w. Engng—March 15, 1918. Details of a recently completed plant at Manchester, England.

Electricity as a Factor in Modern Rolling Mill Operation (85822). L. Rothera. Ills. 3000 w. Pr House—April, 1918. Engineering problems connected with the installation of electric drive.

Pass Limitation in Rolling Mill Practice (85350 A). Alfred Musso. Ills. 700 w. Machy—April, 1918. Shows mechanical relations existing between the different elements and how they control the reduction of the piece.

Power Required by Cold Rolling Mills (85527 A). C. E. Davies 3000 w. Engr—March 15, 1918. Power which should be provided for any size of rolls engaged on a particular class of work

Scrap

Reclaiming High Speed Steel (85607 A). Ills. 1000 w Ry Mech Engr—April, 1918 Recent process converts scrap into first quality new stock

Steel

Nickel-Copper Steel (85699 N). R. W. Leonard. 3500 w. Can Soc C E—March 28, 1918. Gives results of experiments with the process patented by G. M. Colvocoresses.

Steel Plant

Canada's Electric Steel Plant at Toronto (85823 A). Ills. 1500 w. Iron Age—April 25, 1918. Important plant built in fast time to augment the steel supply.

Steel Treating

Principle of the Generation and Application of Heat in Steel Treating (85546). A. F. MacFarland. Ills. 3000 w. Am Mach—April 11, 1918. General principles underlying the selection and use of heat-treating furnaces.

MINE OPERATION

Ferroalloys

To Increase Domestic Ore for Ferroalloys (85710 A). 2500 w. Iron Age—April 18, 1918. Plan for government operation of mines.

Mine Fire

Engineering Problems Encountered During Recent Mine Fire at Utah Apex Mine, Bingham Canyon, Utah (85602 A). V. S. Rood. Ills. 15 pp. Utah Soc Engrs, Mthly Jl—Feb., 1918. Conditions before the fire, during the fire, and after, with account of expenses incurred.

Mine Power

See same heading under ELECTRICAL ENGINEERING, *Power Applications*.

Shafts

Modern Methods of Shaft Sinking (85695 A). W. H. Maxwell. Ills. 2500 w. Colly Gdn—March 28, 1918. Serial, 1st part. Sinking by hand, and the Kind—Chaudron system are considered in the present number.

The Cementation Process of Shaft Sinking (85826 N). E. H. Roberton, with discussion. 3 plates. 4000 w. Min & Geol Inst of India, Trans—Nov., 1917. Describes examples of the application of this process.

"Square Set"

Notas Sobre El Empleo Del "Square Set" En La Explotacion De Las Minas (85865 D). L. C. Espinosa. Ills. 3900 w. Boletin Minero—Oct., 1917. Suggestions for use of the "Square Set" in mining operations.

Strip Mining

Strip Mining Where Bad Roof Prevails (85752). Ralph W. Mayer. 2500 w. Cl Age—April 20, 1918. Coal in Pittsburgh region being recovered profitably by means of stripping. Plan and methods of working.

MINES AND DISTRICTS

East Indies

Ontdekking van belangrijke delfstofafzettingen in Ned.-Indië (85854 B). E. C. Abendanon. Ills. 4500 w. Ingenieur—Feb. 16, 1918. Important discovery of iron and nickel ores in Celebes (Dutch East Indies). Methods of working, estimated extent, etc.

Ontario

Mineral Production of Ontario, 1917 (85459). T. W. Gibson. 2500 w. Can Min Jl—April 1, 1918. Reports concerning gold, silver, nickel and copper, iron, etc.

Quebec

Mineral Production of Quebec, 1917 (85460). Theodore C. Denis. 900 w. Can Min Jl—April 1, 1918. Increase in value of output. Asbestos, copper and sulphur ore, zinc and lead ore, chromite, etc.

Santa Rosalia

Negociacion Minera "El Boleo" (85,864 D). Ills. 1700 w. Boletin Minero—Nov., 1917. The development of "El Boleo" copper property at Santa Rosalia, Bay of California.

Southern U. S.

The South's Share in Furnishing War-Making Minerals (85550). Franklin K. Lane. 1000 w. Mfrs' Rec—April 11, 1918. Some of the useful minerals are iron pyrites, sulphur, manganese, flake graphite, mica, corundum, etc.

MINOR MINERALS

Chrome

Chrome Production and Distribution (85475). Samuel H. Dolbear. 2000 w. Eng & Min Jl—April 6, 1918. Report on the condition of the chrome ore mining industry.

Magnesite

Magnesite Deposits of Washington (85624). R. W. Stone. Ills. 2500 w. Eng & Min Jl—April 13, 1918. Production, history of development, deposits, etc.

Molybdenum

Molybdenum in Norway (85788 N). Ernest R. Woakes. Map. 4000 w. Instn Min & Met, Bul 160—Jan. 10, 1918. The deposits, cost of mining, mines in operation, etc.

Nitrates

The Chilean Nitrate Industry (85796 D). 1200 w. A I M E, Bul—April, 1918. Discussion of paper of Allen H. Rogers and Hugh R. Van Wagenen.

Potash

Discussion on "A Neglected Chemical Reaction and an Available Source of Potash" (85786 N). 23 pp. Instn Min & Met, Bul. 160—Jan. 10, 1918. Discussion on E. A. Ashcroft's paper.

Extraction of Potassium Salts from the Pintados Salar (85626). Roger C. Wells. 1500 w. Eng & Min Jl—April 13, 1918. Experimental work to discover a method of readily extracting.

100,000 Tons of Potash Obtainable from Cement Dust Every Year (85905). Samuel G. Wilmer. Ills. 4500 w. Mfrs' Rec—April 25, 1918. New industry at Security, Md., and its importance.

Potash in the Pintados Salar, Tarapaca, Chile (85625). Hoyt S. Gale. Maps. 2500 w. Eng & Min Jl—April 13, 1918 Saline deposits containing potassium salts. Formation, extent, importance.

L'Industrie Des Sels De Potassium En Temps De Guerre (85887 B). L. Brunet. 8400 w. Rev Générale Des Sciences—Mar. 30, 1918. Potassium industry in war times. Sources, production, methods of extraction, etc.

OIL AND GAS

Infiltration

Reduction of Water-Infiltration in Oil-Wells (85513 A). R. P. McLaughlin. Ills. 1200 w. West Eng—April, 1918. Solution of a serious oil problem.

Oil Prospecting

Principles and Problems of Oil Prospecting in the Gulf Coast Country (85,795 D). 5500 w. A I M E, Bul—April, 1918. Discussion of W. G. Matteson's paper.

Oil Refining

The Solubility of Paraffins, Aromatics, Naphthenes, and Olefins in Liquid Sulphur Dioxide (85681 A). Robert J. Moore, J. C. Morrell and Gustav Egloff. Ills. 5000 w. Met & Chem Eng—April 15, 1918. A study of the possible utility of liquid sulphur dioxide in oil refining and analysis.

Oil-Shale

The Oil-Shale Industry (85615). Arthur J. Hoskin. Map & Ills. 6000 w. Min & Sci Pr—April 13, 1918. Areas of oil-yielding shale. Geology; methods of distillation, etc.

"Paraffin Dirt"

An Interpretation of the So-called Paraffin Dirt of the Gulf Coast Oil Fields (85806 D). Albert D. Brokaw. 1200 w. A I M E, Bul—April, 1918. An interpretation based upon laboratory study.

Vegetable Oils

South's Opportunity to Build Up Great Industry in Vegetable Oil Production (85314). Charles A. Whittle. 1500 w. Mfrs' Rec—March 28, 1918. Emphasizes the opportunity of the vegetable oil industry in the South.

ORE DRESSING

Antimony Smelting

The Practice of Antimony Smelting in China (85805 D). Chung You Wang. Ills. 3500 w. A I M E, Bul—April, 1918. Results of many years experience.

Crushing

Recent Tests of Ball-mill Crushing (85793 D). 4500 w. A I M E, Bul—April, 1918. Discussion of C. T. Van Windle's paper.

Flotation

Cascade Method of Froth-Flotation (85614). H. Hardy Smith. Ills. 3000 w. Min & Sci Pr—April 13, 1918. Details of this process and its advantages. Use of steam for dispersing the oil.

Hand-Sorting

Hand-sorting of Mill Feed (85804 D). R. S. Handy, with discussion. 5000 w. A I M E, Bul—April, 1918. Aims to determine under what conditions hand-sorting pays.

Quicksilver

Loss of Quicksilver in Gold Mills (85,497). W. J. Sharwood. 1200 w. Min & Sci Pr—April 6, 1918. Tables of quicksilver consumption in important gold-mills.

PRECIOUS METALLURGY

Drilling

Drilling on the Lena Goldfield, Siberia (85374). W. E. Thorne. 4000 w. Min & Sci Pr—March 30, 1918. Lack of system; inefficiency of workmen; gold-stealing, etc.

Gold Mining

Imposts on Gold Mining (85372 N). 5500 w. Cham Mines W. Aust, Mthly Jl—Dec., 1917. Critical discussion of the treatment given the gold mining industry in Australia.

See also Quicksilver, under Ore Dressing.

MISCELLANY

Metallurgy

Recent Advances in Canadian Metallurgy (85698 N). Alfred Stansfield. 3500 w. Can Soc C E—March 28, 1918. Advances since the commencement of the war.

Mine Taxation

The Incidence of Taxation upon Metalliferous Mining in the British Isles (85787 N). Henry Louis. 4000 w. Instn Min & Met, Bul. 160—Jan. 10, 1918. Reviews the effect upon the mining industry of the principal taxes upon mining and minerals.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION

Canada

Brain-Racking Problems for Canadian Roads (85443). J. L. Payne. 2000 w. Ry Age—April 5, 1918. Severe winter; shortage of equipment; unprecedented business.

Car Service

Principles and Practices of Car Service Regulation. H. E. Byram. Also, Regulation of Car Service Under Government Control of Operation. John J. Esch (85640 D). 17 pp. An Am Acad—March, 1918. Economic and financial phases; equipment problems: traffic possibilities.

Commissions

Regional Railroad Commissions: Their Relation to the State Commissions and to the Interstate Commission (85657 D). J. E. Love. 2000 w. An Am Acad—March, 1918. Theoretical discussion.

Co-ordination

Co-ordination of All Transportation Facilities (85436). John R. Hall. 3800 w. Ry Age—April 5, 1918. The waste of competition, and the opportunity for combination.

Electric Traction

La Trazione Elettrica (85867 B). F. Tajani. 6700 w. L'Industria—Feb. 15, 1918. Economic and mechanical advantages of electric operation of Italian railways.

Government Control

First Three Months of Government Control (85438). 6000 w. Ry Age—April 5, 1918. Policies being developed for welding railroads into a single system.

Federal Control of Railroads in War Time (85639 D). Max Thelen. 3500 w. An Am Acad—March, 1918. Problems with which the railroads have been confronted during the war, and results expected from government operation.

Government Operation

Government Operation of American Railroads (85644 D). Clifford Thorne. 26 pp. An Am Acad—March, 1918. Outlines some of the essentials of the plan now before the U. S. Congress, and how the plan differs from the one adopted in Great Britain.

Government Operation of Railroads: Legal Aspects (85434). Roberts Walker. 3000 w. Ry Age—April 5, 1918. Owner's and creditor's rights subordinated to Government.

Precedents for Private Ownership and Government Operation of Transportation Facilities (85643 D). Delos F. Wilcox. 13 pp. An Am Acad—March, 1918. Experience in Europe, with discussion of administration bill before the U. S. Congress.

Government Ownership

Government Ownership of the Railroads (85702 A). W. A. Clark. 3000 w. Af Eng Soc Min, Bul—April, 1918. Opposed to government ownership, outlining some of the dangers.

The Necessity for Public Ownership of the Railways (85651 D). Frederic C. Howe. 10 pp. An Am Acad—March, 1918. Favorable to government ownership.

What Government Ownership Would Mean (85439). Samuel O. Dunn. 5500 w. Ry Age—April 5, 1918. Address before Buffalo Club. Effect on other businesses.

Post War Control

Control of Railroads After the War (85648 D). Henry A. Palmer. 2500 w. An Am Acad—March, 1918. Opinions regarding public policy reforms needed; pooling, etc.

A Suggested Plan for Permanent Governmental Supervision of Railroad Operation After the War (85650 D). Alexander W. Smith. 5000 w. An Am Acad—March, 1918. Suggests a permanent federal railroad board.

Present Crisis

Our Transportation in the Present Crisis (85419 A). John F. Lent, with discussion. 6000 w. Ry Cb Pitts, Pro—Feb. 21, 1918. Transportation problems in America during the war.

Railroad Administration

Doings of the United States Railroad Administration (85893). 7500 w. Ry Age—April 26, 1918. Recent important developments.

Railway Personnel

Railway Personnel Under Government Control (85746). 2500 w. Ry Age—April 19, 1918. Policy of the railroad administration.

Signaling

Signal Department Encounters New Problems (85442). 2500 w. Ry Age—April 5, 1918. Shortage of labor and delayed deliveries of materials hinder work.

Missouri Pacific Signal Installation (85498). O. R. Unger. Ills. 1200 w. Ry Sig Engr—April, 1918. New construction methods.

Development of Electric Interlocking (85499). W. S. Henry. Abstract of paper read at Houston, Texas. 4500 w. Ry Sig Engr—April, 1918. Information concerning early development.

Standardization

Chamber of Commerce of U. S. Sounds Warning (85742). 10000 w. Ry Age—April 19, 1918. Papers and discussions on the transportation problem and the operation of transportation facilities of the U. S. after the conclusion of government control.

MOTIVE POWER AND EQUIPMENT

Ambulance Train

An Ambulance Train for the United States Army (85745). Ills. 1200 w. Ry Age—April 19, 1918. Train built by L. & Y. Ry. Runs between the front and base hospitals in France.

Ash Pans

Locomotive Ash Pans (85425 A). Ills. 1800 w. Ry & Loc Eng—April, 1918. Development under the federal law: varieties in design.

Cars

Norfolk & Western Composite and All-Wood Cars (85424 A). Ills. 1500 w. Ry & Loc Eng—April, 1918. Interesting features of gondola and box cars.

Can the Freight Car Situation Be Improved? (85454). 1500 w. Ry Age—April 5, 1918. Maintenance problem is serious.

Electric Locomotives

Baldwin-Westinghouse Passenger Locomotive for the C., M. & St. P. R. R. (85607 A). F. H. Shepard. Ills. 12 pp. N Y Rd Cb, Pro—March 15, 1918. Design and construction of this new 240 ton D. C. 2400-volts locomotive.

Schwere Güterzulokomotive der Bernina Bahn (85861 B). 900 w. Schweiz Bauzeitung—Feb. 23, 1918. New electric locomotives for Bermina Railway Switzerland, for work on steep grades and through heavy snow.

New 180-Ton Locomotives for the New York, New Haven & Hartford Railroad (85606 A). E. R. Hill. Map & Ills. 1500 w. N Y Rd Cb, Pro—March 15, 1918. Describes new electric locomotives designed to haul heavy passenger trains over the steep grade of the Hell Gate bridge.

Ten Powerful Baldwin Westinghouse Electric Passenger Locomotives for the Chicago, Milwaukee & St. Paul Railway (85427 A). Ills. 1700 w. Ry & Loc Eng—April, 1918. Twin motor design with quill drive.

The 3000 Volt D. C. Gearless Locomotive for the C., M., & St. P. R. R. (85608 A). A. H. Armstrong. Ills. 7 pp. N Y Rd Cb, Pro—March 15, 1918. Details of locomotive having bi-polar motors.

Engine Failures

Engine Failures—Their Chief Causes and Prevention (85426 A). 1300 w. Ry & Loc Eng—April, 1918.

Equipment

Physical Needs of the Railways Under Government Control (85641 D). Julius H. Parmelee. 16 pp. An Am Acad—March, 1918. Reviews recent traffic history and attempts a forecast of future traffic developments and needs.

Gasoline Locomotives

U. S. A. Gasoline Locomotives (85486). Ills. 1500 w. Auto Ind—April 4, 1918. Built in three sizes for use on tracks behind the battle lines.

Locomotive Handling

Terminal Handling of Locomotives (85789 A). Frank C. Pickard, with discussion. Ills. 32 pp. Cent Ry Cb, Pro—March, 1918. Suggestions for maintaining their efficiency.

Locomotives

Railroad Administration's Motive Power Problem (85574). Alba B. Johnson. Read at Chicago meeting of U. S. Chamber of Commerce. 3300 w. Ry Age—April 12, 1918. The development of the American locomotive and the possible effects of standardization.

Standardization of Locomotives: Great Central Railway (85684 A). Ills. & Plate. 2000 w. Ry Engr—March, 1918. 2-8-0 mineral engines: selection of the design by the ministry of munitions.

Why Locomotives Should Not Be Standardized (85441). 3000 w. Ry Age—April 5, 1918. Reasons against standardization of locomotives for United States railways.

Lubrication

Difficulties of Locomotive Lubrication (85353). 2500 w. Ry Rev—March 30, 1918. Exposition of existing conditions. A committee report of Trav. Engrs. Assn.

Truck Bolsters

Freight Car and Tender Truck Bolsters (85665 A). G. S. Chiles and R. G. Kelley. Ills. 3300 w. Ry Mech Engr—April, 1918. Serial, 1st part. General principles involved in the design, loading and testing of truck bolsters.

U. S. Standard Cars

Designs of United States Standard Cars (85447). Ills. 2000 w. Ry Age—April 5, 1918. Noteworthy features.

Specifications for the United States Standard Cars (85331). 3000 w. Ry Age—March 29, 1918. Seven types of bodies for box, hopper and gondola cars, and three types of trucks.

United States Railroad Administration's Freight Car Equipment Standards (85352). Ills. 3500 w. Ry Rev—March 30, 1918. Résumé of the freight car equipment specifications.

United States Standard Freight Car Equipment (85494). Ills. 900 w. Ry Rev—April 6, 1918. General construction of the 55 and 70-ton hopper cars with details of some of the castings and other parts of eight designs.

The United States Standard Cars (85664 A). Ills. 20 pp. Ry Mech Engrs—April, 1918. Specifications and principal drawings of the new freight cars to be purchased by the government.

United States Standard Steel Sheathed Box Cars (85576). Ills. 500 w. Ry Age—April 12, 1918. Details of construction and design.

U. S. Standard Engines

Tentative Specifications for Standard Locomotives (85747). 1200 w. Ry Age—April 19, 1918. General dimensions of the twelve locomotives proposed.

Latest Developments in Locomotive Standardization (85894). 1500 w. Ry Age—April 26, 1918. Roads permitted to ask for special designs for conditions not met by standard types.

Modern Versus Standardized Railway Equipment (85892). J. E. Muhlfeld. 2500 w. Ry Age—April 26, 1918. Discusses the adoption of standard types of locomotives.

PERMANENT WAY AND BUILDINGS

B. & O. Grades

Baltimore & Ohio Grade Separation at Pittsburgh (85744). Ills. 2500 w. Ry Age—April 19, 1918. Main tracks raised on an earth fill and steel viaduct for more than a mile.

Labor Shortage

The Labor Shortage in the Maintenance Department (85446). 2000 w. Ry Age—April 5, 1918. Possible sources of supply and means of reducing demand.

Maintenance

Large Expenditures Needed for Maintenance of Way (85453). 1200 w. Ry Age—April 5, 1918. Deficiency in upkeep.

Rails

Transverse Fissures in Steel Rails (85792 D). Ills. 12000 w. A I M E, Bul—April, 1918. Discussion of J. E. Howard's paper.

Why Busy Rails Do Not Rust (85832 N). Oliver P. Watts. 2500 w. Am El-Chem Soc—April-May, 1918. Experimental investigations.

Repair Shops

The Locomotive Repair Shop Situation (85445). 2500 w. Ry Age—April 5, 1918. Railways need increased facilities.

Shop Scheduling

Shop Scheduling on the B. R. & P. (85666 A). Ills. 1200 w. Ry Mech Engr—April, 1918. Output increased, and supervision reduced.

Terminals

The Railway Terminal Problem (85613). John F. Wallace and Edward J. Noonan. 3500 w. Ry Rev—April 13, 1918. Read at Chicago meeting of U. S. Chamber of Commerce. Arrangements of terminals in cities.

The Terminal Question (85605). H. J. Pfeifer. 15 pp. St L Ry Cb, Pro—March 8, 1918. Explains the activities of the Terminal Railroad Assn. of St. Louis.

Weighbridge

Plate Fulcrum Track Weighbridge (85416 A). Ills. 1500 w. Engng—March 8, 1918. A railway weighing machine for the Pennsylvania R. R.

Y. & M. V. Improvements

Improvements on the Yazoo & Mississippi Valley (85330). Ills. 1700 w. Ry Age—March 29, 1918. Track grades on 44 miles of line near Wicksburg, have been raised to protect against floods.

ROADS AND PROJECTS

China

China's Greatest Need Today Is Transportation (85333). Ills. and Map. 3500 w. Ry Age—March 29, 1918. Has only 6,000 miles of railway and practically no good roads.

Construction

Railway Construction as Affected by the War (85449). 1800 w. Ry Age—April 5, 1918. Review of the situation.

Siberia

Railway Systems of Siberia (85768). W. G. Mitchell, in *Russia*. An abstract. Ills. 4000 w. Ry Rev—April 20, 1918. Details of construction, maintenance and operation of this vast system.

TRAFFIC

Demurrage

How to Prevent Freight Car Demurrage (85848 A). Dwight T. Farnham. Ills. 2500 w. Ind Man—May, 1918. Standard practice instructions for loading and unloading cars to facilitate movement.

Freight

Regulations for Reconsignment of Carload Freight (85577). 4500 w. Ry Age—April 12, 1918. New rules covering all reasonable demands.

Waybill

Universal Interline Freight Waybill Adopted (85332). 1000 w. Ry Age—March 29, 1918. To be used with or without through rates.

MISCELLANY

Railway Supplies

Is the Supply Field Interested in "Free Ports"? (85452). E. S. Swazey. 3000 w. Ry Age—April 5, 1918. Free ports and their activities: dangers, results, etc.

Our Foreign Trade in Railway Supplies (85575). P. Harvey Middleton. 3000 w. Ry Age—April 12, 1918. Information of value to those who aim to supply foreign fields.

The Railway Supply Field Prospects for 1918 (85451). 1500 w. Ry Age—April 5, 1918. Recent changes in this field.

The World Market for American Railway Supplies (85440). A. Stephens. 5000 w. Ry Age—April 5, 1918. Necessity of preparing for after-the war business.

STREET AND ELECTRIC RAILWAYS

Buenos Aires

La Nouvelle Usine Électrique de la Compania Italo-Argentina (85858 B). P. Calfas. Ills. 2800 w. Le Genie Civil—Mar. 16, 1918. New power station at Buenos Aires of the Italo-Argentine Electric Co.

Car Bodies

Car Bodies Must Be Designed for Economy as Well as Strength (85774). Norman Litchfield. Ills. [illegible] w. Elec Ry Jl—April 20, 1918. Considers design and construction.

Car Design

Savings Attainable with Present-Day

Car Design (85194). Norman Litchfield. Ills. 3500 w. Elec Ry Jl—March 16, 1918. How car design affects operating economy.

Car Equipment

Betterments Available in Car Equipment (85195). C. W. Squier. Ills. 6800 w. Elec Ry Jl—March 16, 1918. Where to use newer motors and control, etc.

Service Conditions Determine Car Equipment Characteristics (85772). C. W. Squier. Graphs. 1500 w. Elec Ry Jl—April 20, 1918. Traffic data required before choosing motor equipment.

Car Maintenance

Better Car Maintenance an Urgent Necessity (85199). M. B. Lambert. 1000 w. Elec Ry Jl—March 1, 1918. Suggestions for shop repairs.

Coal Economies

Power Production in War Times (85236). Walter C. Slade. Abstract of address before New England St. Ry. Cb., Boston. 3000 w. Elec Ry Jl—March 23, 1918. Problems of coal delivery and station operation.

Columbus, Ohio

Columbus Company's Idea of a Modern Station (84707). Ills. 2500 w. Elec Wld—March 2, 1918. Interesting features; considerable electrical equipment outdoors.

Walnunt Plant, Columbus Railway, Power and Light Co. (84717). Ills. 4000 w. Power—March 5, 1918. Features of interest of a plant having a capacity of 31,250 kv.-a.

New Power Source for Columbus (Ohio) Railways (84699). Ills. 2500 w. Elec Ry Jl—March 2, 1918. Most of the electrical equipment is out of doors. No reciprocating units.

Congested Traffic

Staggered Hours for 88,000 Washington Employees (85473). John A. Beeler. From report on electric railway situation. 3500 w. Elec Ry Jl—April 6, 1918. Proposes new hours for employees in capital city to relieve traffic.

Elevated

Manhattan Elevated Railway Improvements (85321 D). Ills. 9 pp. A S C E, Pro—March, 1918. Discussion of paper by F. W. Gardiner and S. Johannesson.

Labor-Saving

Labor-Saving Methods in the Way Department (85198). Roy C. Cram. Ills. 4500 w. Elec Ry Jl—March 16, 1918. Analyzes the possibility of utilizing many machines and tools in the up-keep of track.

Lightning Arresters

Protecting Car Equipment Effectively Against Lightning (85775). R. T. Wagner. Ills. 3000 w. Elec Ry Jl—April 20, 1918. How best to install and maintain car-type aluminum arresters.

Melbourne

The Tramways of Melbourne (85884). 1100 w. Times Engng Supp—Mar. 29, 1918. A cable system for the street railways. Extensions contemplated.

Montreal

Power Distribution for the Montreal Tramways (84817). Ills. 1500 w. Elec Ry Jl—March 9, 1918. Design considerations in the rehabilitation of the power system.

Motors

Ventilated Motors During a Strenuous Winter (85196). R. E. Hellmund. Ills. 3000 w. Elec Ry Jl—March 16, 1918. Neglected commutator covers of old motors gave more trouble than clogged drain holes of ventilated type.

Overhead

Certain Overhead Department Economies (85193). Charles R. Harte. Ills. 3500 w. Elec Ry Jl—March 16, 1918. Saving by doing overhead repair work with power equipment.

Rail Return

Sur Le Réseau De Retour Des Tramways (85851 D). F. Guery. Ills. 7300 w. Bul Soc Internationale Des Électriciens—Feb., 1918. Calculation of voltage drop in rails; size of feeders required, etc.

Shops

Electric Car Repair Shops at Torrance, California (84903 A). Carroll R. Harding. Ills. 2500 w. Corn C E—Jan., 1918. Details of new plant and study of design.

Substations

Automatic Substation of New Type on Ohio Electric (85619). R. J. Wensley. Ills. 1800 w. Elec Ry Jl—April 13, 1918. Details of a new type of equipment.

Designing and Operating the Substation for Maximum Efficiency (85618). Ills. 3000 w. Elec Ry Jl—April 13, 1918. Details of the Cedar Ave. substation of the Cleveland (Ohio) Railway.

Sous-Station Du Chemin De Fer De Paris A Arpajon (85872 B). L. Pahin. Ills. 1200 w. L'Industrie Électrique—Mar. 25, 1918. Sub-station of the Paris municipal railways at Arpajon. Rotary converters and other equipment.

Savings Effected by Automatic Substations (85617). H. E. Davis. Ills. 1500 w. Elec Ry Jl—April 13, 1918. Details of automatic operation of one of four substations on the Oneida line of N. Y. State Railways; analyzing the economies.

Testing

The Testing Organization of Electric Railways (85197). Hartley LeH. Smith. Ills. 5500 w. Elec Ry Jl—March 16, 1918. Analysis showing the usefulness of such a department.

Track

Greater Uniformity in Track Spirals Will Conduce to Economy (85472). E. M. T. Ryder. Ills. 1500 w. Elec Ry Jl—April 6, 1918. Desirability of standards, showing that co-operation could bring about great simplification.

Track Construction Methods Employed on Great Street Widening Plan (85340). Ills. 2200 w. Elec Ry Jl—March 30, 1918. New type of sub-grade construction; complete rebuilding of double-track of Chicago surface lines.

Valuation

Valuation of Competitive Transportation Systems in the Vicinity of San Francisco (85512 A). E. N. Prouty. Map. 2500 w. West Eng—April, 1918. From data submitted to the Calif. State Rd. Com. by cities of Berkeley and Alameda.

BOOK NOTICES

MECHANICAL ENGINEERING

AVIATION ENGINES, by Lieutenant Victor W. Page. Size, 5½ x 8½ inches; 590 pp.; ills. Price, $3.00. New York: The Norman W. Henley Pub. Co. This work on the types of motors commonly used in airplanes is extremely comprehensive forming a treatise on internal combustion engines in general, with a great deal of information on the repairing and location of troubles in such motors. Certain portions of the book have been censored by the Committee on Public Information of the United States Government. There is a large amount of matter that will be found invaluable to the student who is preparing himself to become an aviator, as well as to the untechnical reader as well. Lieutenant Page's previous works on automobiles and internal combustion engines have attracted wide publicity and the present book should prove no exception to the rule. There is an excellent index, and the arrangement of subjects, beginning with the theory of operation of combustion engines, carrying the reader on to the details of such motors through the subjects of. lubrication, handling, etc., the final completed aeroplane engine leaves but little to be desired.

AMERICAN LUBRICANTS by L. B. Lockhart. Size, 6 x 9 inches; 236 pp.; ills. Easton, Pa.: The Chemical Publishing Company. This is an excellent compact treatise on the subject of petroleum and its products as used for lubricants. A number of examples are given of the methods of testing lubricants for a great variety of purposes. The general principles of lubrication are treated and the best methods of lubricating steam and gas engines, as well as electrical and other machines are dwelt upon at some length. Lubricating greases and fatty oils are also taken up in considerable detail and not the least valuable feature of the book is a set of tables of viscosity, specific gravity and other constants as applied to lubricants.

GEOLOGY

AUSTRALIAN GEOLOGY. Two pamphlets with maps. Perth: Australian Government Printing Offices. These two sets of maps issued for the years 1916 and 1917 respectively under the authority of the Minister of Mines of Australia, contain 59 large maps, many of them in colors showing the geological formation and ore deposits of the largest gold fields in Australia. The 1916 volume treats of the Murchison fields, while the 1917 issue shows very fully the formation of the widely known gold deposits of Kalgoorlie and Coolgardie, which have attracted so much attention in recent years. Copies may be obtained from F. W. Simpson, the Controller of Printing at Perth.

MANAGEMENT

THE SCIENCE OF MANAGEMENT, by Frederic A. Parkhurst. Size, 6 x 9 inches; 204 pp. Price, $3.00. Cleveland, Ohio: The Case School of Applied Science. This is a compact treatise on management worked up from a series of lectures given at the Case School of Applied Science by the author. The 30 chapters in it comprise among other topics, history and fundamental principles of management, the first essentials to applying these principles, the subject of planning, the routing and control of work and such widely discussed topics as stores, labor and costs. Further on in the book the topic of bonus is taken up with a certain amount of space devoted to time studies. It would be difficult in the space permissible in such a book as this to treat so comprehensive a subject with anything like thoroughness, but the author appears to have made quite clear the general principles upon which it rests and has explained the latter by numerous examples from practice.

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Factory and industrial
management

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